No. 2611 VOLUME 75 FRIDAY 6 FEBRUARY 1959

FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

Official Organ of the Royal Aero Club First Aeronautical Weekly in the World Founded 1909

Editor-in-Chief
MAURICE A. SMITH D.F.C.

Editor
H. F. KING M.B.E.

Technical Editor
W. T. GUNSTON

Production Editor
ROY CASEY

IN THIS ISSUE

Missiles and Spaceflight 179
Frank Bernard Halford, 1894-1955 183
Flying Fords 185
Rolls-Royce Reversers 187
Flight-testing the Vanguard 188
Eastern Routes Jet 190
Dart Overhaul by B.E.A 194
Secsyn 195

Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1; telephone Waterloo 3333. Telegrams Flightpres Sedist London. Annual subscriptions: Home £4 15s. Overseas £5. Canada and U.S.A. $15.00. Second Class Mail privileges authorized at New York, N.Y.

Branch Offices Coventry: 8-10 Corporation Street; telephone Coventry 25210. Birmingham: King Edward House, New Street, 2; telephone Midland 7191. Manchester: 260 Deansgate, 3; telephone Blackfriars 4412 or Deansgate 3595. Glasgow: 26B Renfield Street, C.2; telephone Central 1265.
New York, N.Y.: Thomas Skinner & Co. (Publishers) Ltd., 111 Broadway, 6; telephone Digby 9-1197.

© Iliffe & Sons Ltd., 1959. Permission to reproduce illustrations and letterpress can be granted only under written agreement. Brief extracts or comments may be made with due acknowledgement.

The Writing on the Navaid Wall

THERE are strong indications that the voting at the I.A.T.A. technical policy-making meeting in Nice last month went heavily in favour of Vortac as the standard international short-range navigation aid—and did so without the formality of technical assessment of the requirements or of the proposed aid itself. I.A.T.A. has thus been led blindfolded into the American camp in readiness for the forthcoming I.C.A.O. Montreal meeting to decide on a new standard aid.

It is universally recognized that any new aid which is adopted must primarily facilitate air traffic control; and an area-coverage aid as the effective means of achieving this aim was suggested after individual detailed studies by the I.C.A.O. Jet Operations Requirements Panel, the American Curtis committee, the International Federation of Airline Pilots' Associations, and the British M.T.C.A. But the Americans have flatly stated that Vortac will be installed in their own country whatever happens. The I.A.T.A. technical committee seems to have been persuaded to endorse this anomalous position.

Vortac itself emerged from a historic dispute as a compromise for a new American common civil/military aid. The military had demanded standardization of Tacan, a new tactical beacon originally designed for operation from small ships and submarines, while the civil authorities clung mainly to VOR, which was already an international standard. Now Vortac (or, more precisely, its Tacan distance-measuring element) is being pushed hard as a new standard for the whole world—pending development of yet another aid sometime in the future.

Distance measuring may help jet-airliner pilots to judge their let-down points, but it will not help them through the slower traffic at lower levels. It may allow reduction of longitudinal spacing on beacon-defined airways. But demonstration flights during the Vortac symposium last year clearly showed the extra communications traffic involved; and communications can become a major bottleneck. Questions about limitations to the capacity of Vortac are always answered in America with the magic word radar; but radar demands yet more communications. The papers read at the symposium seemed to indicate that all the problems had been carefully weighed, and the international audiences were politely credulous.

Now, while the unavoidably ponderous I.C.A.O. machinery moves slowly towards international agreement, there is a strong tendency to climb on the Vortac bandwagon simply in order to achieve some sort of result quickly. The reasoning goes that Vortac will in any case be necessary in the U.S.; that it can probably be implemented quickly; that the Americans seem to be solving the worst air traffic problem in the world with it; that just a few Vortac beacons might fill the bill until the final aid arrives; and that there will be plenty of Vortac going free. Only the first and last of these arguments stand up to close scrutiny, but the reasoning is being potently reinforced at every opportunity.

Whether as a result of persuasion or dragooning, the reluctant and the doubters are being gathered into the Vortac fold. Decisions are being taken in spite of, or even in the face of, all the technical assessments. But they will provide no lasting solution to the pressing problem of controlling growing traffic; and that is, after all, the crucial question facing I.C.A.O. or any other civil aviation authority. The reported I.A.T.A. vote at Nice may be the writing on the wall. We can only hope that I.C.A.O. will not be forced to follow this unhappy example.

FROM ALL QUARTERS

Bristol Siddeley Engines

DETAILS of Bristol Siddeley Engines Ltd., the new organization formed by the merger of Armstrong Siddeley Motors Ltd. with Bristol Aero-Engines Ltd., were announced last week.

Hawker Siddeley and the Bristol Aeroplane Company, respectively the parent group and holding company, are now acquiring in equal proportions the whole share capital of Bristol Siddeley Engines (formed last year as a link between Armstrong Siddeley Motors and Bristol Aero-Engines); and the newly formed concern is in turn acquiring the complete share capital of Armstrong Siddeley Motors and Bristol Aero-Engines and will take over the operations of both companies. It is also to acquire Bristol Cars Ltd.

Board membership of Bristol Siddeley Engines Ltd. is as follows: Sir Reginald Verdon Smith, chairman; Sir Roy Dobson, vice-chairman; Mr. H. T. Chapman, deputy chairman (resident in Coventry); Sir W. Alec Coryton, deputy chairman (resident in Bristol); Sir Arnold Hall, managing director; A. Cdre. F. R. Banks, sales director; Mr. B. Davidson, commercial director; Mr. G. L. Hack, assistant production director; Dr. S. G. Hooker, technical director (aero); Mr. W. H. Lindsey, technical director (non-aero); Mr. W. Masterton; and Mr. W. F. Saxton, production director.

Dr. E. Warlow Davies, at present deputy chief engineer of Bristol Aero-Engines, will become chief engineer (aero) of Bristol Siddeley Engines and is to be a special director. Other present directors of Armstrong Siddeley Motors and Bristol Aero-Engines who do not become members of the new Board but who continue in their present executive positions—i.e., Mr. J. E. Attwood, Mr. J. Innes and Mr. R. Ninnes—will also be special directors.

Sir Mark Norman, at present secretary of Bristol Siddeley Engines, will become executive assistant to the managing director; and he is to be succeeded in his former position by Mr. F. T. Blakey, at present secretary of Armstrong Siddeley Motors. Mr. F. M. Burns, at present financial director of Bristol Aero-Engines, will become chief accountant of Bristol Siddeley Engines.

In terms of manpower, it is believed that (possibly excluding Russia) the new company is the third largest aero-engine concern in the world, next in size to Pratt & Whitney and Rolls-Royce. In terms of research and development and production facilities the Bristol Siddeley organization is thought to be the leading company of its kind.

Honours for Designers

TWO famous aircraft designers were honoured last week. In Paris on January 27 it was announced that Andrei Tupolev, designer of the Tu-104, had been awarded the F.A.I. (Fédération Aéronautique Internationale) gold medal for 1958. In New York on the following evening, at an honors night dinner of the Institute of the Aeronautical Sciences, Sir George Edwards was made an Honorary Fellow of the Institute. This presentation to the managing director of Vickers-Armstrongs (Aircraft) Ltd. followed appropriately the maiden flight of the Vanguard only a week before. Presented with an Honorary Fellowship at the same time as Sir George (two honorary fellows are elected each year, one a U.S. resident) was Dr. C. S. Draper, head of the Department of Aeronautics and Astronautics at M.I.T.

The 23rd Paris Show

AS in previous years the Paris Show (June 12-21) will have certain days devoted to special topics. This year there will be a Press and pre-view day on June 11, and the 14th will be set aside for commercial aviation. The 18th will be a day of "gyraviation" and the 20th will be an "international flight demonstration." The main international flying show will be on June 21. Days will also be set aside for aviation and space medicine, ambulance flying and light and sporting aviation.

Merits Rewarded

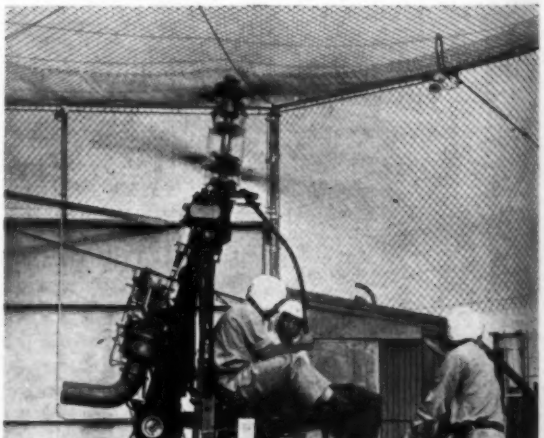
AWARDS by the Royal Aero Club for 1958, announced last week, are headed by that of the Britannia Trophy to G/C. John Cunningham and Mr. Peter Bugge of the de Havilland Aircraft Co. for their test-flight work on the Comet 4. The club's gold medal goes to Lord Brabazon for his services to aviation; the silver medal to Mrs. Ann Welch, for her contribution to the gliding movement and as manager of the British team in the world championships; and the bronze medal to Sgt. A. W. Gough of the R.A.F., for his "selfless devotion to teaching others to fly over a long period" and his British distance record of 347 miles during last year's R.A.F.G.S.A. contests. This is said to be the first time an R.A.F. glider pilot has been so honoured by the Royal Aero Club.

The Geoffrey de Havilland Trophy for 1958 has been awarded to Lt-Cdr. D. F. Robbins, R.N., for the London to Valetta point-to-point record of 2 hr 12 min 27.2 sec (at 588.04 m.p.h.) which he set up last June in a Vickers Supermarine Scimitar.

RDa.10 Type Test

LAST December a Rolls-Royce Dart RDa.10 turboprop successfully completed a 150 hr type-test to the combined U.S./U.K. civil type-test schedule. The declared dry rating was 2,660 e.h.p. (2,400 s.h.p. plus 670 lb thrust) and over 60 hr were run at this power during the test.

Rolls-Royce confirm that this is by no means the ultimate Dart rating (last June we announced a 25 hr flight-approval test at a military wet rating of 3,200 s.h.p.). Since the Dart's introduction to scheduled service in 1953 the maximum overhaul period has increased from 400 to 2,200 hr; total airline Dart hours are now over 6.5m and are increasing at more than 250,000 hr each month.



TINY TITAN: The Solar Aircraft Company's Titan gas turbine undergoes ground tests in a Gyrodyne Rotocycle helicopter rig. Mounted behind the pilot, this 55 h.p. turbine unit—the smallest of its kind in the world—has considerable instrumentation attached. The exhaust duct is a temporary fitting

UNCOMFORTABLY CLOSE: This picture of a Chinese Nationalist Air Force Sabre was taken by J. M. Ramsden of "Flight" from a B.O.A.C. Comet 4 on a civil airway near Formosa last Friday. The Chinese pilot intercepted the Comet, which was en route from Hong Kong to Tokyo, at about 37,000ft, and flew a few feet from the wing-tip for about five minutes

CRAFT OF COMMERCE: A new and pleasing study of the Armstrong Whitworth Argosy (four Rolls-Royce Dart). This first Argosy has been making up to three flights a day. New details of progress are reported on this page

Alvis Changes

TWO changes have been announced in the Aero Division of Alvis Ltd. Maj. R. E. Nicoll, until recently commercial director of Westminster Airways Servicing Ltd., is succeeding Mr. T. C. Wallace as sales manager; and Mr. T. F. Lenton takes over as service manager from W/C. F. White, who is emigrating to Australia.

Maj. Nicoll, who began flying with the R.N.A.S. and R.A.F. in the First World War and then went to Canada as a commercial pilot, was with Handley Page before joining Westminster Airways Servicing in 1953. Mr. Lenton has been with Alvis since 1938

Maj. Nicoll

Mr. Lenton

and as a member of the service department was responsible for the prototype installation and flight trials of such aircraft as the Provost, Rotodyne and Westland S.51.

W/C. White, who has been service manager for five years, is to act as Australian correspondent for Alvis on all aeronautical affairs. His temporary address is c/o Bristol Aircraft Services, Bankstown, Sydney, N.S.W.

The Easy-Going Argosy

AFTER three weeks of test-flying the first Armstrong Whitworth Argosy, Eric Franklin, the maker's chief test pilot, reports that the aircraft is extremely simple to handle. The Argosy has been making up to three flights a day—some of them of three hours' duration; but mist and fog have grounded the aircraft for quite long periods. Airfield performance should exceed design specification. In one landing at a gross weight of over 70,000 lb (about 8,000 lb below the design maximum landing weight) the Argosy touched down and came to rest, with no reverse thrust, in 450 yd. Take-off at about 72,000 lb has been achieved with ease in 700 yd, without the pilot pulling the aircraft off. Low-speed handling is particularly impressive.

The Tyne-Powered Bréguet 1150

A NATO committee is soon to make a decision regarding the Bréguet 1150 naval patrol, reconnaissance and anti-submarine aircraft which, a French source states, "has already been selected on technical grounds." Weighing about 38 metric tons and powered by two 5,380 h.p. Rolls-Royce Tyne turboprops, the 1150 would, if ordered, be jointly built by Bréguet and Sud in France, Fokker in Holland and Dornier in Germany.

Noratlas Round-up

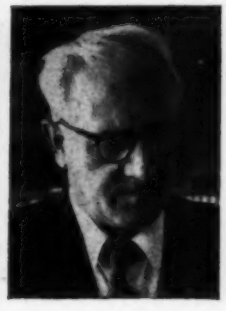
TOTAL orders for the various derivatives of the Nord 2500 Noratlas amount to 353. They comprise: French Air Force, 200; West German Air Force, 112; French airlines and export orders, 41. Virtually all these aircraft are powered by twin 2,040 h.p. Bristol Hercules engines, licence-produced by SNECMA. The Noratlas machines for the West German Air Force are being manufactured in Germany by the Northern group (Hamburger, Weser and Siebel); the first was delivered last September and production has now reached the peak rate of four monthly.

The TSR.2 Again

REPLYING to questions in the House of Commons on January 28, the Secretary of State for Air, Mr. George Ward, said that the TSR.2 would be supersonic, but would not be capable of vertical take-off and landing. It would operate from short runways with semi-prepared surfaces. The Swallow was "an even further advanced design" and would have a much later time-scale. Compared with the NA.39 the TSR.2 would have a much shorter take-off and landing run and much better facilities for blind navigation over land. A modified version of the NA.39 would have had to be radically redesigned and would have cost a great deal in research and development. We would not have got it any earlier and it was therefore better to start with a brand-new conception. It was intended to have the TSR.2 in service in the mid 1960s.

Mr. Ward used the description "Operational Requirement

ENGLISH ELECTRIC POSTS: Here, from left to right, are Mr. R. F. Creasey, director of engineering, Aircraft Division, Mr. F. D. Crowe (chief engineer) and Mr. A. E. Ellison (chief designer); Mr. L. H. Bedford, director of engineering, Guided Weapons Division, and Mr. G. R. Jefferson (chief engineer). Their appointments, with others, follow the formation of English Electric Aviation Ltd.; details appear on page 197



***BREMEN-BUILT:** Flight trials of the Borgward Kolibrie I three-seat helicopter (Lycoming 260 h.p. flat-six) have been in progress since July last year, but no illustration has previously been available. This unskinned prototype will be followed by a series-production version*

FROM ALL QUARTERS . . .

No. 330" in respect of the strategic supersonic bomber that was cancelled.

The decision to develop the TSR.2, he said, was made just over a year after the general operational requirement was first released for study by industry.

Asked by what means it was intended to give the TSR.2 the ability to operate from small fields, Mr. Ward replied, "By a combination of high engine power, advanced wing design and a special undercarriage." He added later that the range of the aircraft would be substantially greater than that of the latest Matador flying bomb derivative known as the Mace. [The range of the Mace is officially described by the makers and the U.S.A.F. as "over 650 miles."—Ed.]

Answering a later question, Mr. Ward said that he thought that Coastal Command was the best-equipped maritime force in the world. "We certainly have never treated it like a poor relation," he commented.

Of Transport Command Mr. Ward said that the AW.660 would supplement the Beverleys and Hastings at present in service. The Valetta had been withdrawn from service in Transport Command and Middle East Air Force, and was gradually being withdrawn from service elsewhere overseas.

Equipment for NATO

TO an increasing degree, aircraft and missiles for the NATO countries are to be developed and manufactured on a co-operative international basis. Several reports state that a standard surface-to-air missile will be the Raytheon Hawk, which is at present under development for the U.S. Army and is characterized by its mobility and by the ability of its C.W. monopulse radar to discriminate between ground clutter and hedge-hopping targets. It is unofficially reported in both Washington and Paris that Western Germany, France, Belgium, Holland and Italy will manufacture and operate the Hawk as a major project, with the U.S.A. injecting a small sum to speed the initial stages.

Among aircraft, the categories so far agreed include those of VTOL strike, lightweight strike fighter, ASW aircraft, maritime reconnaissance and medium assault transport. Hawker Aircraft have a contender in the first category; the engine is said to be a fan version of the Orpheus under development by Bristol-Siddeley, with some U.S. financial support. Many interests are offering "Neptune-replacement" aircraft ranging from helicopters to a four-Eland version of the DC-7. At present it seems likely that the winning design will be that by a group headed by Bréguet. France and Germany are said to be co-operating in the development of an assault transport. Powered by Rolls-Royce Tynes, the aircraft is to weigh 99,000 lb and have a payload of 17,600 lb (a poor ratio), and the first machine off a production line could be flying within two years (see also Bréguet ASW, page 177).

IN BRIEF

Dr. A. M. Ballantyne, secretary of the Royal Aeronautical Society, has been elected a Fellow of the Institute of the Aeronautical Sciences.

* * *

The M.o.S. announces that Dr. T. S. England has been appointed Head of Airborne Radar at the Royal Radar Establishment, Malvern.

* * *

Mr. Jan Meijer Drees, formerly with Nederlandse Helicopter Industrie and chief designer of the Kolibrie, has joined Bell Helicopter Corporation as senior research engineer.

* * *

On Monday this week Philip Moyes returned as press officer to the S.B.A.C., which he left in early 1957 to join the Bristol Aeroplane Co. Ltd. Alexander Johnston remains head of the Society's press and information department.

* * *

Cargo weighing 52,000 lb was loaded aboard a Douglas C-133A Cargomaster in 1 hr 10 min at Travis A. F. B., California, recently. In the demonstration, 36,000 lb cargo on pallets was put aboard the C-133 from 40ft flatbeds, followed by four turboprop engines weighing 4,000 lb each. Unloading—by five men and a fork-lift—took 50 min.

* * *

All industrial activities of the Hawker Siddeley Group have now been brought together into one company, Hawker Siddeley Industries Ltd. This will be under the chairmanship of Sir Roy Dobson and its joint managing directors are Sir George Briggs and Mr. Arthur Frampton. The announcement follows a similar one (*Flight*, January 30) inaugurating Hawker Siddeley Aviation Ltd.

* * *

Designed for air-lifting—especially by helicopter—a new jeep-type vehicle produced by American Motors Corporation weighs only 1,700 lb. Known as the Mighty Mite, it is powered by an air-cooled vee-four engine (almost entirely made of aluminium alloy) weighing 303 lb and developing 55 h.p. The vehicle, which has four-wheel drive, has a wheelbase of only 65in; overall length is 107in, and width 61in.

* * *

Mr. Henry Kremer, chairman and managing director of the Microcell Group, and Dr. W. D. Scott, assistant managing director of BTR, who has just joined the Board of Microcell under the recent merger, flew to New York last Sunday in connection with two licensing projects—the completion of arrangements for the manufacture of certain U.S. electronic equipment under licence in Britain, and the negotiation of agreements for the manufacture of Microcell products in the U.S.A.

* * *

The Indonesian Government signed a contract with the Fairey Aviation Co. Ltd. on January 27 for the supply of eighteen Gannets. These will be former R.N. machines which are to be fully reconditioned and equipped with new Armstrong Siddeley Double Mambas. This work will be done at the Fairey factories at Hayes and White Waltham. Mr. Richard Fairey, vice-chairman of the company, said in Melbourne on January 28 that Indonesia would pay about £A4m (£3,200,000) for the aircraft.

***GROUND RECOGNITION:** A recent photograph of the Flying Wing at R.A.E. Bedford with the officer commanding, W/C. S. McCreith, seated in the middle of the front row. Also sitting, from left to right, are Lt.-Cdr. P. I. Normand; S/L. S. J. Hubbard; Zeta, S/L. Hubbard's Boxer, who appears to be taking a distant perspective and not much interest in the picture; S/L. B. J. L. Greenland and Mr. D. J. Taylor. Standing, from left to right, are F/Ls. L. W. F. Stark; P. B. Rea; A. J. Camp; and M. S. Goodfellow; Lt-Cdr. J. S. Humphreys; and F/L.s A. Bountiff and F. W. Bell* Crown copyright photograph

Missiles and Spaceflight

AFTER living with astronautics on an informal basis for some considerable time, *Flight* is happy to make an honest science of her by formally introducing this regular weekly section, which will contain news and feature articles on many international aspects of spaceflight. It appears inevitable at the present time for much of the total rocket and space technology effort to be directed into "defence" channels, and so missiles are part of the title above. This section's début coincides with a change in *Flight's* sub-title to *Aircraft, Spacecraft, Missiles*, which is intended to reflect the journal's current scope.

In the field of astronautics it is our hope that these pages will not only record the advances of individual nations, but will indicate the limitless possibilities which a combined international effort could achieve. It is our belief that the exploration of space should be carried out rationally, by United Nations teamwork, and not irrationally by individual countries trying to catch up with or beat the other side.

Although already there happens to be a Soviet coat-of-arms in orbit around the Sun, this in itself is no valid reason to plant Union Jacks on the Moon or to look for more stars to add to Old Glory. The International Geophysical Year demonstrated the ability of scientists and engineers in many countries to obtain valuable data by space research and to work together effectively: the world has given politicians and Service chiefs no mandate to extend national barriers into space.

Flight's first fifty years have seen phenomenal progress, from the Wright and Voisin aeroplanes described in our first issue to the half-missile, half-aircraft North American X-15 which is just beginning its flight programme. Progress, that is, from man's first powered hops into the air to his first ventures into space. The future of spaceflight is a challenging subject—and one that is awesome in its implications.

Thor plus miniature version of Titan guidance system launched on January 23 (news item below)

SPACE DISCUSSED BY I.A.S.

Speaking at the Honors Night Dinner at the 27th annual meeting of the Institute of the Aeronautical Sciences in New York last week, the administrator of the National Aeronautics and Space Administration, Dr. T. Keith Glennan, said that the first occupants of the U.S. manned satellites were now being selected from 110 volunteers. These would be reduced to twelve by the end of March, and the final selection would be made just before initial tests began in about two years' time. (As reported in *Flight* of January 16, the prime contractor for the Project Mercury manned satellite programme is McDonnell Aircraft.)

Those who were finally chosen, Dr. Glennan said, would be (1) university graduates with a degree in the physical sciences or engineering, (2) graduates of a military training school for test pilots, with at least 1,500 flying hours, (3) under 40 years of age, and not taller than 5ft 11in, and (4) "in superb condition, with the physical and psychological attributes best suited for spaceflight, as determined by aeromedical scientists now working on the project."

A number of papers on aspects of spaceflight were presented at the I.A.S. meeting, and a panel discussion on the objectives of space exploration was held. This discussion is the subject of a special report overleaf.

FASTER FLIGHT-TEST

For many years aircraft manufacturers have hastened development by using existing aeroplanes to flight-test portions of a machine still under construction. Typical cases are the Short Sunderland which carried the fin and rudder of the SA.4 Sperrin, and the Martin B-57 which was fitted with the fore-body and guidance system of an IM-99 Bomarc missile. The picture above illustrates the process applied to the field of ballistic missiles.

Early on the morning of January 23 there was fired from Cape Canaveral a Thor acting as carrier vehicle to what was described as "a miniature version of the new Titan ICBM guidance system." Titan's guidance is a self-contained, all-airborne, all-inertial package developed by Bosch Arma. It is not an overstatement to describe the system as the most advanced yet to have reached the production stage. It is housed chiefly in the second stage of the missile, the diameter of which is rather more than 6ft. The contrivance carried by the Thor on January 23 appears to have been about one-quarter scale. It was reported to have travelled some 4,400 miles, indicating the provision of propulsion in the second stage. Titan itself has completed some months of static firing in the "battleship" stand at Martin's Denver division, but attempts to get a round off at Cape Canaveral have not yet achieved success. The first abortive launching occurred on December 20.

WEST COAST DISCOVERY

Unlike all the U.S. satellite launchings attempted to date (which have been from Cape Canaveral, Florida), the forthcoming Project Discoverer firings will be made from Vandenberg A.F.B., California, over the Pacific missile range. Launching vehicle tests will be followed by animal-carrying satellite firings.

Early Discoverer vehicles will use a modified Thor as first stage, with a Lockheed-developed second stage powered by a modified version of the Bell rocket motor originally intended for the powered-bomb pod of the Convair B-58 Hustler. Atlas will later be used in place of Thor as the first stage.

SOVIET ROCKET INSTRUMENTS

Among details recently released of the rocket launched into solar orbit by the Soviet Union on January 2 was a description of the equipment carried. The final stage of the rocket was stated to contain (in addition to "devices guaranteeing a normal flight") the following items: The airtight and detachable instrument container; two transmitters operating on 19.997 and 19.995 Mc/s; a cosmic ray counter; "a radio system determining the trajectory of the flight of the rocket and predicting its further movement"; and the apparatus for forming the "artificial sodium comet."

The container consisted of two airtight semi-spherical cases joined together by cross-ribs and a special rubber sealing ring. One of the half-cases, as illustrated in *Flight* of January 23, carried four aerial rods (for a radio transmitter operating on 183.6 Mc/s). Also carried on this section was a magnetometer probe.

Inside the container were the following pieces of equipment: (1) radio (operating on 183.6 Mc/s) for controlling the rocket's trajectory, (2) radio transmitter operating on 19.993 Mc/s, (3) telemetry for conveying scientific data to Earth, (4) proton traps

Missiles and Spaceflight . . .

for the study of the gas component of interplanetary matter and of solar corpuscular radiation, (5) magnetometer for the measurement of the Earth's magnetic field and the detection of the Moon's magnetic field, (6) ballistic piezo-electric meters for the study of meteoric particles, (7) two charged-particle counters for registering the intensity of cosmic rays and (8) two photo-multipliers for studying the composition of cosmic radiation.

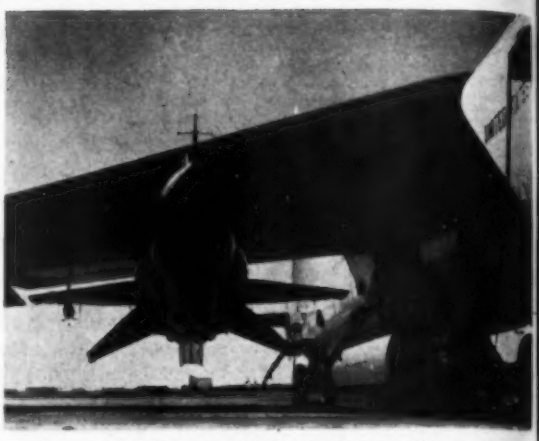
The radio and scientific equipment in the container was powered by silver zinc accumulators and mercury oxide batteries. The container was filled with gas at a pressure of 1.3 atmospheres and its internal temperature was maintained at about 20 deg C.

BIG TOE INTO SPACE

This year's flight programme of the North American X-15 was described last week by Dr. T. Keith Glennan, director of the U.S. National Aeronautics and Space Administration, as "stretching our big toe into the edges of space." Dr. Glennan was speaking before the Senate Preparedness Subcommittee in Washington on January 30, and the first flight of the X-15 (secure under the wing of a B-52) is likely to take place next week.

Before the end of the year, Dr. Glennan said, the X-15 should reach an altitude of 100 miles, launched from the B-52 at about 40,000ft and propelled by its two liquid-fuel rocket engines (firing for 90sec) into a ballistic trajectory. It was planned to launch the machine near Wendover A.F.B., Utah, and for it to land at Rogers Dry lake, Edwards A.F.B., California.

The North American company test pilot for the early X-15 flights will be Scott Crossfield, who will demonstrate the machine's potential without reaching its performance limits. Three "customer" pilots will then take over for further flight-testing; Capt. Robert A. White, U.S.A.F., Mr. Joseph A. Walker of NASA, and Lt-Cdr. Forrest S. Petersen, U.S.N. Two further X-15 vehicles are now approaching completion at North American's Los Angeles plant and are scheduled for delivery by June this year. Overall cost of the X-15 project has been quoted as $123 million.



North American X-15 mounted beneath B-52 wing. Three main attachments are used plus quick-disconnect supply lines for nitrogen and liquid oxygen. Fuselage blister houses closed-circuit television camera

FOR THE RECORD

The proceedings of the 8th International Astronautical Federation Congress, held in Barcelona in 1957, have recently been published by Springer-Verlag, Vienna. Papers presented on that occasion are grouped into general astronautics, upper-atmosphere research, physics of spaceflight and astrophysics, astronautical engineering, propulsion, artificial satellites, space biology and medicine, and space law. The publication is available through the British Interplanetary Society, 12 Bessborough Gardens, London, S.W.1. The 1959 international astronautical congress will be held in London during the week beginning August 31.

WHY EXPLORE SPACE?

"OBJECTIVES of Space Exploration" was the title of a discussion session on January 27 at the four-day annual meeting of the Institute of the Aeronautical Sciences in New York. Firstly, should we speak about "man in space," or "Ph.D. in space"? This question was posed in humorous vein by Prof. Guyford H. Stever of Massachusetts Institute of Technology, the chairman of a panel well qualified to discuss the serious aspects of the subject.

The "man" need not be an astronomer, replied Mr. Leo Goldberg, chairman of Michigan University's Astronomy Department, who cited the "observation of electromagnetic radiation" as the highest-priority task facing science in its initial study of outer space. Everything known thus far about radiations had been derived from measurements taken at the bottom of the ocean of air surrounding our planet. The atmosphere absorbed most ultraviolet radiation and parts of the infra-red spectrum. Virtually all electromagnetic radiations between 0.5 and 30 Mc/s were absorbed upon entry into the protective air blanket.

To view these radiations in outer space, Goldberg suggested that the forthcoming satellites be equipped with stabilized platforms and suitable detectors for "reconnaissance of the Sun's ultraviolet spectrum" and radiations from the planets and stars. The possible existence of vegetation on Mars had been reported by some astronomers, and placing a telescope beyond the atmosphere would assist in exploring this possibility.

Satellites might also prove useful in resolving the question of whether the "gravitational constant" was indeed constant. There had been speculation in many quarters, the speaker reported, that the constant varied slightly. Placing a "gravitational clock" in a satellite and comparing its readings after several years with those from an Earth-based atomic clock might reveal slight changes.

Mr. Stever inquired at this point whether the payload capabilities of existing rocket engines were sufficiently large for the required scientific exploration. He noted that current Thor/Atlas vehicles were capable of placing 200-8,000 lb payloads in a 300-mile orbit around the Earth; 600-3,000 lb in the vicinity of the Moon; and 1,500 lb as far as Jupiter. The "million pound" rockets under development would be capable of placing 25,000-50,000 lb payloads in 300-mile orbits around the Earth. It was agreed that these rockets would be adequate for the experiments contemplated at present.

Prof. Bruno Rossi, an expert on cosmic rays from the Physics Department of M.I.T., thought that it would be unnecessary to send a cosmic-ray specialist into outer space in the early stages of space exploration. Cosmic rays had a very high penetrating power and could be observed through the Earth's atmospheric cover. But there were three reasons for sending an instrumented vehicle into outer space: to look back at the Earth; to look around at our planetary neighbours; and to look beyond our solar system.

Looking back at the Earth had several obvious and oft-stated benefits. Looking around in outer space would provide science with the first opportunity to escape the Earth's magnetic field and to view and understand the hydromagnetic environment which surrounded our planet. Specifically, the interplanetary "weather" (in the form of magnetic storms), the "plasma" which fills the solar system, and the density, velocity, temperature and magnetic strength of the Sun's radiations were of interest.

Being a completely spontaneous discussion the session covered a wide variety of topics, and detail questions and problems were frequently raised. Mr. George Valley, director of development planning of Melpar, Inc., cited the problem of communications over long ranges, such as from Mars. As yet there was no reliable long-life electronics capable of withstanding the rigours of spaceflight. The development of interplanetary electronic and other equipment might in fact be as difficult, and require as much time and experiment, as the development of the rocket engines themselves. The development of a drill, for example, capable of boring into the Moon's surface might require considerable effort.

In reply to a question whether orbital or glide vehicles would be logical military weapons beyond ballistic missiles, Mr. James R. Dempsey, manager of Convair-Astronautics, stated that it was not clear to him that such systems met the prime requirement of all practical weapons. A new weapon system must be capable either of performing a new mission, or of carrying out an existing mission better (either in terms of people or money) than some existing weapon. Orbiting weapons did not at present meet these requirements, according to Mr. Dempsey.

Dr. Simon Ramo, executive vice-president of Thompson Ramo Wooldridge, Inc., perhaps summarized the meeting when he stated that space research had three main objectives. The first, and the most urgent at the present time, was to obtain information which would increase the military preparedness of the U.S.A. With the present cold war, it was far easier to obtain government support for space research if the end-results had military overtones (all the assembled scientists agreed that a great deal of research was being carried on under the "space banner," simply because "space" was a popular cause which enjoyed widespread popular support). Another reason for space research was that it showed promise of improving life on earth. Improved weather forecasting techniques and communications should result from current space explorations. The third main reason was simply that of pure research—the better to understand Nature.

DONALD A. IMGRAM.

Missiles and Spaceflight . . .

RE-ENTRY RESEARCH: THE LOCKHEED X-17

MACH numbers of 15 to 20, air stagnation temperatures of some 20,000 deg F and probable heat transfer rates of several thousand B.T.U.s per sec per sq ft of surface are among the aerodynamic conditions involved in the re-entry phase of the flight of long-range and intermediate-range ballistic missiles. At the time when the U.S. Air Force began to develop its present generation of such weapons, these conditions could not be simulated by any conventional test facility. The result was the development, at the request of the Air Force Ballistic Missile Division, of the Lockheed X-17 hypersonic test vehicle.

This vehicle and its applications were the subject of a recent paper (at the 13th annual meeting of the American Rocket Society in New York) by Mr. Ronald Smelt, director of research of the Lockheed Missile Systems Division, and the information in Mr. Smelt's paper has formed the basis of this article. As indicated, the primary object of the X-17 was to provide design information on the critical problem of re-entry. Propelled by solid-fuel rockets, and much smaller than the ballistic missiles whose re-entry it simulated, it could be put into operation much more cheaply and rapidly than the full-scale vehicle.

Design of the X-17 began in February 1955, and in July 1956 it gave the first flight data on heat transfer reached at the Mach numbers and Reynolds numbers of typical re-entry. Since that time 26 X-17 vehicles have been launched in the Air Force re-entry programme, 20 of which have been successful in providing data.

As shown in the diagram the X-17 has a three-stage tandem configuration. Separation of the second stage is achieved by an explosive charge usually fired by a pressure switch, and thrust from the third-stage motor separates this stage approximately three seconds later. The rocket motors for all three stages are manufactured by the Thiokol Chemical Corporation and comprise an XM-20 Sergeant for the first-stage booster, a cluster of three XM-19 Recruits for the second stage and an XM-19E1.

Two methods of aerodynamic stabilization are used. The first stage is stabilized by lifting surfaces consisting of four straight-tapered fins with a four-per-cent thick biconvex section arranged in cruciform; and second and third stages by conical skirts.

In addition to aerodynamic stabilization, dispersion is minimized by spinning the first stage to about two rev/sec at launch using two small spin rockets clamped to the outside of the XM-20 rocket case. These are jettisoned after use.

To obtain realistic Reynolds numbers, the small scale of the X-17 must be compensated by making measurements at altitudes lower than those of the full-scale missile. The major difficulty is then to impart the necessary hypersonic velocity. This is achieved by applying thrust during re-entry by means of the following technique.

Only the first stage is employed to reach maximum altitude, which is usually more than 500,000ft for a launch angle of 85 deg. The first-stage motor burns out at about 90,000ft, when the velocity of the vehicle is slightly over 5,000ft/sec, and the vehicle coasts to apogee and into the descent. At a predetermined point on the descent, the first stage is separated and the second stage fires, followed in about three seconds by the third stage. This increases the velocity rapidly into the hypersonic regime.

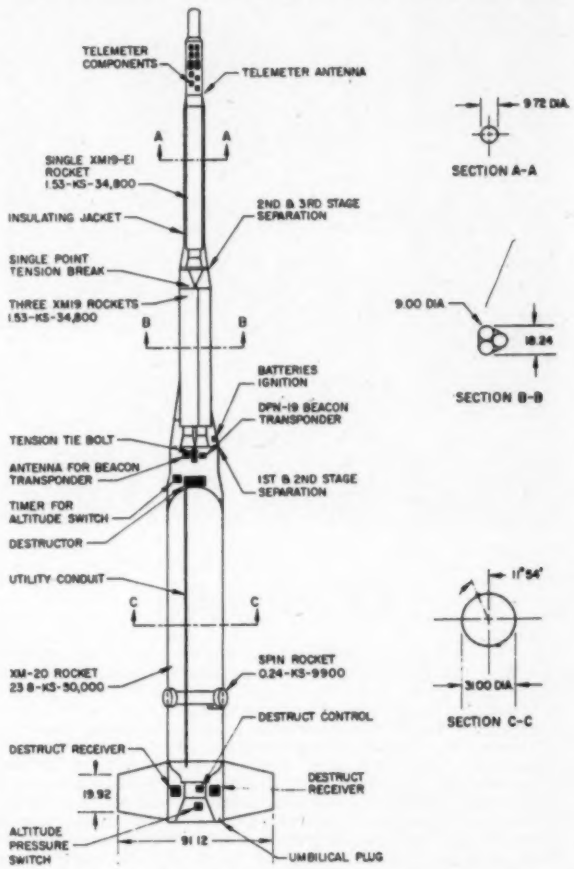
Most of the data obtained from the X-17 is still regarded as classified information at present. It can be said, however, that the large number of flights made in the re-entry research programme have provided aerodynamic information for a very wide variety of nose shapes, ranging from simple hemispheres to more complex shapes. Pressure distributions measured at Mach numbers up to 15 have shown excellent agreement with current hypersonic blunt-body theories. Distribution of heat-transfer coefficient over the surface in both laminar and turbulent flow has been determined over the same Mach-number range.

Perhaps the most valuable contribution has been in the experimental determination of the criteria for transition of laminar to turbulent flow on a re-entering vehicle. The position of the transition point is of vital importance in determining re-entry heating of ballistic missiles. Surface roughness as well as nose-cone contour was varied during the tests.

The maximum Mach number attained, approximately 15, is adequate for direct application to IRBMs but is less than that at which high heating rates may be expected in re-entry from satellite orbit or LRBM trajectory—although actual heating-rates encountered during the X-17 experiments were well in excess of those expected on these higher-speed vehicles.

For the future, one obvious possibility is to employ in the X-17 the improved solid propellants which are now available. This would permit the vehicle to deliver an instrument payload of 50 lb to a height of over 1,000 miles, and to extend re-entry aerodynamic testing to Mach numbers above 20. At the present time, however, a more appropriate direction for development appears to be towards an economical solid-rocket propelled instrumented satellite.

In this launching picture, the two spin rockets clamped to the first-stage case are seen firing

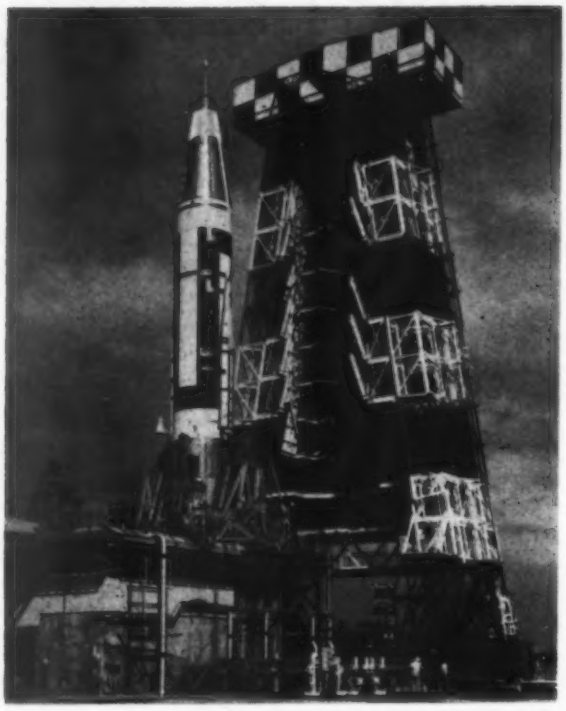


Location of equipment in the X-17 test vehicle. Total length of the rocket at launch is 40ft 5½in; the final stage measures 10ft 1in

X-17 ROCKET MOTOR CHARACTERISTICS

Rocket Motor Type	XM-20 Sergeant	XM-19 Recruit	XM-19E1
Performance (sea level):—			
Web burning time (70 deg F) (sec) ...	23.8	1.53	1.53
Average thrust (70 deg F) (lb)	50,000	34,861	35,950
Total impulse (70 deg F) (lb-sec) ...	1,344,000	57,024	58,800
Total impulse/initial weight (sec) ...	164	164	169
Specific impulse (sec)	191	216	223
Weights (lb):—			
Case	768	66.5	66.5
Nozzle	295	15.6	15.6
Liner	89	2.6	2.6
Propellant	7,033	264	264
Total	8,185	348.7	348.7

Missiles and Spaceflight . . .



ATLAS ABC

AS was outlined in our 1958 Missile Review issue of December 5 last, the Convair SM-65 Atlas—part of Weapon System 107-A-1 of the U.S. Air Force Strategic Air Command—is the first intercontinental ballistic missile in the Western world. It is a vehicle of unique design, incorporating the following features: a "one and one-half stage" configuration, with a central sustainer engine and two boost engines, all fired on the ground; an airframe incorporating integral tankage sections made from stainless steel of so thin a gauge that it has to be pressurized to maintain its rigidity; a curious radio-inertial guidance system, in which very powerful General Electric ground radar and a Burroughs digital computer combine to monitor the flight path and compare the predicted impact point with the known co-ordinates of the target; twin vernier mbtors carried on pylons for close control of the final trajectory; and gimbal-mounted main engines to provide coarse control during the early stages of flight. The warhead is housed in a separable nose-cone, which is so designed as to survive the arduous conditions consequent upon re-entry into the atmosphere.

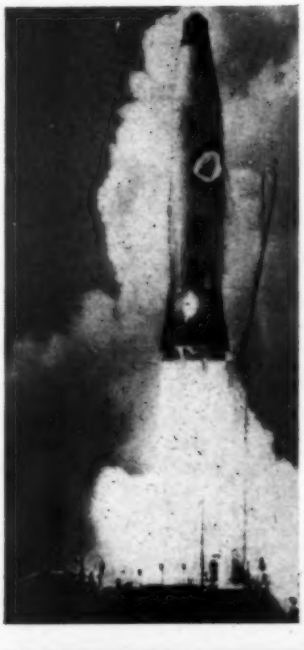
The heading photograph shows one of the early Atlas A test vehicles (the first of which was fired on June 11, 1957). These rounds were intended to prove the basic ability of the vehicle to be transported, statistically fired, launched and flown under the power of the two 165,000 lb-thrust Rocketdyne LR-93 boost engines. Later A models incorporated guidance systems. Altogether eight were fired, none failing to leave the pad cleanly and four actually reaching the boost shut-off or burn-out point without suffering serious failure.

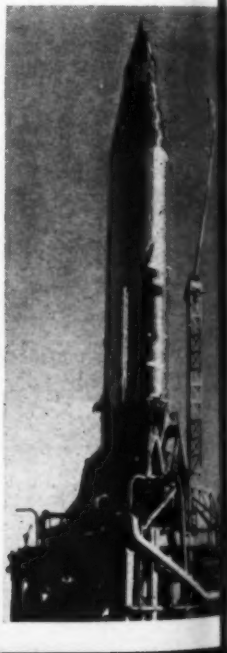
Photograph 2 (first right) illustrates one of the first of the Atlas B models. As the picture clearly indicates, these rounds incorporated two maior additional items: the 54,000/60,000 lb-thrust LR-105 sustainer engine and the blunt G.E. Mk 1 nose-cone and corrugated re-entry body. Thus the vehicle moved very much closer to the operational configuration, and the eight B missiles permitted flight-testing of the integrated three-engine propulsion system, the radio-inertial guidance and the separable nose-cone and warhead. The round depicted was actually the second B to be fired, the date being August 2 last year. It was the first B to achieve a successful flight, covering a distance of some 2,500 miles. The full design range of 5,500 nautical miles (6,333 statute miles) was not achieved, partly owing to the somewhat early design of the airframe and consequent poor inbuilt mass-ratio, but chiefly owing to the ponderous overload of instrumen

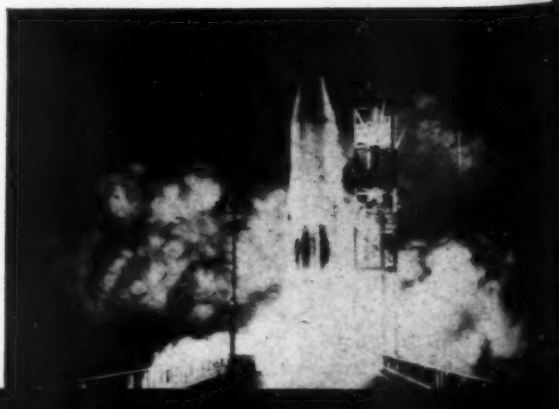
In the third illustration (below, right) can be seen a u Atlas: the Project Score satellite vehicle. Fired successfully f Cape Canaveral on December 18 and believed to have burned on January 21, this round was the last of the B series, and in pla of the weighty warhead and re-entry body it carried a wi recorder and radio transceiver housed within a lightweight, po nose-cone. It was officially stated that the following data appl to this round: Velocity at burn-out, 17,100 m.p.h.; thrust at se level, approximately 359,000 lb; powered flight time, 4½ min perigee, 118 miles; apogee, 625 miles; expected orbital life, 20 da (actual life believed 34 days); weight of body in orbit, approxi mately 8,800 lb; weight at launch, approximately 244,000 lb.

In the final illustration (at foot of page) is seen the first Atlas C, the fully operational version. Fired on Christmas Eve, this round was the first to incorporate important airframe refinements, such as chemically milled skirt sections surrounding the boost engines, which effect a welcome reduction in structure weight and raise the mass-ratio to the point at which the full design range can actually be exceeded. Another—and less expected—change is that this first operational version of the Atlas has a completely inertial guidance system. The chosen equipment is the very sophisticated and attractive system designed by Bosch Arma for the SM-68 Titan missile. Owing to the fact that Titan is some twelve months behind Atlas in timing it has been decided to fit the Titan guidance into the first Atlas C missiles and, if need be, to put the radio-inertial equipment into the early Titans.

In the round illustrated the Arma system was not actually coupled to the engines, but was used to telemeter back data. This missile went "less than the full range," and distances of 4,000 and 4,500 miles were unofficially reported both for it and for the second Atlas C, fired on January 27. At the time of writing a total of 19 Atlas had been fired, one resulting in the missile going into orbit and 12 others being rated as "successful." So far it appears that only one round—a stripped-down B model fired on November 28—has gone the full design range, but this should soon be a matter of course. A squadron of 10 Atlas is expected to be "in initial operational readiness" at Cook A.F.B., Cal., by June. Francis E. Warren A.F.B., Wyo., will be equipped by December.







FIRST HALFORD LECTURE DELIVERED BY J. L. P. BRODIE

"In Frank Halford it could be said a light always shone, sometimes a flicker, sometimes a blaze. In the generations who worked with him and those who will follow, the same light still shines. It will never be quenched. So be it."

Concluding paragraph of Mr. Brodie's lecture

Frank Bernard Halford, 1894-1955

THE first Halford Lecture was due to be delivered yesterday, February 5, by Mr. J. L. P. Brodie, M.I.Mech.E., F.R.Ae.S., Hon.M.S.L.A.E. (engineering director, the de Havilland Engine Co. Ltd.) before the Hatfield branch of the Royal Aeronautical Society at Hatfield Technical College.

Mr. Brodie's paper recalled how Frank Halford learned to fly at Brooklands in 1913, when he was 18, and within a few months became an instructor at the Brooklands School of Flying. Later he was an engine examiner in the Aeronautical Inspection Directorate of the War Office. No doubt this experience at a formative time of his life brought him into touch with the types of engine then in use. Early in the 1914-18 war he joined the Royal Flying Corps and served in France, initially as a sergeant. The authorities, however, were not inclined to let him continue such a precarious existence and he was brought back to develop the 160 h.p. Beardmore engine with a view to designing a more powerful unit. This he did with Arrol-Johnston in Dumfries, and the outcome was the B.H.P. (Beardmore-Halford-Pullinger)—a 230 h.p. vertical six-in-line water-cooled engine embodying cast-iron cylinder heads, steel cylinder liners, and sheet-steel water jackets. In the B.H.P. Halford departed from the practice of using single large inlet exhaust valves, and used two small exhaust valves and a single large inlet valve per cylinder. The design was turned over to Siddeleys, who changed the cylinder heads and water jackets to aluminium and the name to Puma. They made over 6,000 Pumas.

Mr. Brodie continued: "I served my apprenticeship with Arrol-Johnston during this period and still have a vivid recollection of a very handsome young man, resplendent in uniform with an R.F.C. cross-over tunic and impeccable brown jackboots. He was a captain in 1916 and set many a female heart fluttering; but the only flutter in which he seemed to be interested related to valve springs.

"The B.H.P. and later Puma were installed in the D.H.4, designed by Capt. (now Sir Geoffrey) de Havilland. Thus began a close relationship between two great men—men who knew that the engine had to fit the aeroplane and the aircraft to take all it could from the engine. Most B.H.P.s and Pumas, however, flew in D.H.9s and many a pilot could and will vouch for the excellence of that combination."

A vee-twelve engine of 500 h.p., called the Atlantic, and using the B.H.P. cylinder assemblies followed, but the war ended before the heavy bombers (ordered for the bombing of Berlin) could come into service. Many years later Mr. Brodie learned that a good number of Atlantics were installed under tight-fitting engine hatches in innocent-looking, but rather deceptive, boats. They were used during the Prohibition period for certain operations off America's eastern seaboard.

Following the development of the B.H.P. the need for more power at altitude was becoming urgent, so in conjunction with Harry Ricardo (now Sir Harry) Halford set about designing a supercharged form of the engine. This, however, was not supercharged in the sense we understand today: there was no gear- or exhaust-driven blower. The system employed introduced a stratum of inert exhaust gas and clean air to the crowns of the working pistons. The effect of this dilution was to weaken the mixture strength in the cylinder at low altitudes. Increase of altitude brought more of this mixture into use, until at heights of between 10,000ft and 20,000ft it became wholly effective in the working cycle. Confirmed by test, indicated thermal efficiencies of 34 per cent were obtained and the fuel consumption fell to 0.465 lb/b.h.p./hr.

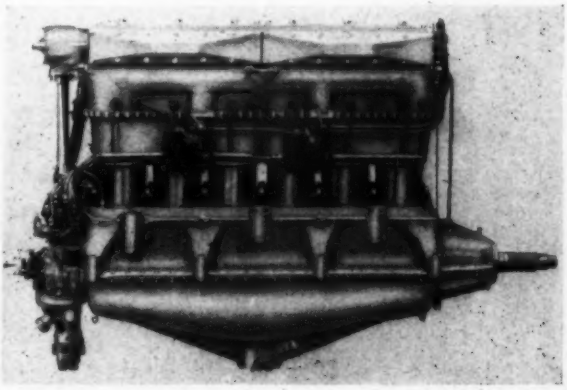
"When the engine was initially designed," the lecturer went on, "it was apparent that the height above the crankshaft centre-line was prohibitive in that it obstructed the pilot's view forward. A solution was found by inverting it and a new design was established. But how to sell it to the powers that were? Here the services of one of the best technical artists of our time, F. Gordon-Crosby,* were brought to bear and resulted in the wholly imaginative painting of a D.H.4. The wonderful forward vision over the engine cowling and through the propeller was apparent. The painting sold the design. Three of this engine and three of a 12-cylinder type R.H.A. (Ricardo-Halford-Armstrong) were made, but the end of the war brought about a cessation of their development."

It should be noted, said Mr. Brodie, that in this later period of the war Halford was appointed assistant to A. E. L. Chorlton, who was then in charge of aircraft engine production at the Air Ministry; but he really did not have his heart in the job. No doubt his very good friend Major G. P. Bulman could tell some instructive and amusing stories of that time. By 1918 Halford already had a considerable string of very fine engine designs to his credit. But the end of the war brought a slump in aviation activity and he joined Ricardo's, spending two and a half years in the U.S.A. disposing of licence agreements for Ricardo patents, notably the turbulent combustion chamber and the slipper piston. He told of his exultation in securing an interview with Henry Ford in an effort to interest him in taking up a licence for the slipper piston. Halford's joy was shortlived, however, when Ford asked him how much Ricardo was prepared to pay for its adoption in Ford engines.

Returning to this country in 1921, Halford assisted in the design and development of the 500 c.c. Ricardo Triumph single-cylinder motor cycle. This went one step further than the B.H.P. in its valving arrangements by adopting two exhaust valves and two inlet valves. With this machine Halford set up several records at Brooklands, including an hour record of just under 70 miles. He also raced it in the T.T. in the Isle of Man.

In 1923 Halford severed his connection with Ricardo and struck out on his own ("but not quite," the lecturer added, "because I joined him again then"). Mr. Brodie proceeded to discuss a very interesting racing-car engine built in 1923 which was ultimately redesigned and made submersible for use in lifeboats. He continued, "In 1924 we entered into a fascinating phase. A vast collection of wartime engines was assembled at the Aircraft Disposal Company of Waddon, Croydon. This company had purchased practically the whole of the country's stocks which existed at the end of the war. I have heard it estimated at 30,000 engines but perhaps this is an exaggeration. Halford's task was to modernize such of them as held a sales potential. The 80 h.p. vee Renault came first and by redesign of the cylinder head and valve gear it was re-rated at 140 h.p. and called the Airdisco.

**Gordon-Crosby was best known for his action studies of early motor races in our sister journal "The Autocar"—Ed.*



The Siddeley Puma, developed from the Beardmore-Halford-Pullinger

Frank Bernard Halford 1894-1955 . . .

About this time de H. was looking around for an engine suitable for a light aeroplane he was designing. It seemed natural that he and Halford should get together on this problem. As a result the Cirrus happened along. It was half an Airdisco and the first engine was built in a remarkably short time, rated originally at 60 h.p. So again the combination of these two men, who were so geared together, produced a very successful aeroplane—the Moth—and set the foundation for what was to become probably the most widely used series of light aircraft in the world.

"Another wartime engine which received Halford's attention at A.D.C. was our old friend the Puma. Quite large quantities were being sold for the equipping of the then new Russian Air Force and it was thought that an up-rated edition would have a market. Thus the Nimbus by Halford out of Puma. The cubic capacity was increased from 18.85 litres to 20.7 litres and the r.p.m. from 1,400 to 1,600, thus producing 335 h.p. for 665 lb weight. Very commendable at that time. A stiffer crankshaft was needed to suit the higher output and by a remarkable stroke of good fortune it was found that the Atlantic shaft, with slight modifications, was suitable, and was used."

Other redesigns of wartime engines were undertaken, notably the 300 h.p. Fiat, Wolseley Viper and the Sunbeam range named after African tribes.

The Moth, in common with most other aeroplanes, was clamouring for more power, and to meet the need a Mk II edition of the Cirrus was produced, rated at 80 h.p. This was achieved by the embodiment of a new cylinder head and valve gear, together with a redesign of the induction system. Most of this period was interspersed with hectic effort in the installation of the 1½ litre in the Aston Martin chassis and all the many troubles which arose therefrom: also from its successful career at Brooklands. This saw the end of Halford's association with the Aircraft Disposal Company and the offices were moved from Croydon to Victoria. There the Gipsy range of engines was born. These included the Gipsy I, Gipsy II, Gipsy III (this latter the first of the inverted types of Gipsy engines), Gipsy Major, Gipsy Six, Gipsy Ghost 8-cylinder vee, and Gipsy Twelve (with reversed-flow cylinder cooling), and just before the war the beautiful little Gipsy Minor.

Between the wars Halford came to a working arrangement with D. Napier & Son Ltd. and was responsible for the design of the Rapier, the Dagger, and the Sabre series of engines. The Rapier, a 16-cylinder double-crankshaft engine of 8.55 litres capacity, ran at 3,500 r.p.m. and fired pairs of cylinders simultaneously. Rated at 400 h.p. and weighing 720 lb, it was installed in the D.H.77, Fairey Seafox and the top component of the Mayo composite aircraft. The Dagger, a 24-cylinder double-crankshaft engine of 16.8 litres capacity, ran at 4,000 r.p.m. developing 1,000 h.p. It was installed in the Hawker Hector and Handley Page Hereford. The Sabre was a larger engine of 36.7 litres running at 3,700 r.p.m., ultimately developed to give 3,100 h.p. It had twenty-four water-cooled cylinders and Halford used single sleeve valves. In its day it was the most powerful piston engine in operation in the world and saw service in the Hawker Typhoon and Tempest.

During this period growing pains were being suffered in the offices in Victoria and a move was made in 1929 to new offices in Golden Square. The staff now numbered seven. Little did the moguls of the tweed industry (who were domiciled there) know of the vital work for aviation which was proceeding in their midst. About this time several diversionary designs were undertaken, including the Hayes transmission. A fully automatic gear with overdrive was manufactured for the 18 h.p. Austin car. Other automobile activities included the redesign, to their advantage, of valve gear in at least two well-known British cars.

The need for closer liaison with de Havillands was becoming pressing; and the company built for Major Halford, in their Stag Lane Works, a suite of offices which was occupied in 1937, the staff then totalling 52. Many of them remain today. W. H. Arscott, E. S. Moult and many others had joined years before. The outstanding feature of this organization was the close-knit and happy relationship of each to the other engendered by Halford. It still continues. Arscott and Moult had transferred much of their effort to Napiers but the centre of activity was largely maintained at Stag Lane, where the whole of the de Havilland output was then located. Engines, aircraft and propellers were designed, developed and produced under one roof.

The Halford Laboratory at Hatfield

With the coming of the Second World War engine design work at Edgware fell initially in the doldrums. One rather exciting job undertaken was the installation of the Gipsy Six engine in the belly of a Wellington. It drove an alternator (which, in the main, consisted of the motor of a London trolleybus) for energizing a 50ft-diameter coil mounted under the fuselage and wings of this aeroplane. It was successful in sweeping the coasts of Britain of magnetic mines. Eventually five were transferred to the Middle East and used to keep the Suez Canal open. Another task undertaken about this time was the design and development of an auxiliary unit for supplying power to the Shetland flying-boat.

It was in 1941 that Halford entered the field of jet propulsion. At the request of Sir Henry Tizard he undertook the design of the original H.1 (later Goblin). This engine achieved its rated output of 3,000 lb thrust within three months of its initial running date. It was a measure of the enthusiasm and effort in our wartime factories that from the day the first detail drawing was issued until the first engine was mounted on the test bed a period of 248 days elapsed. The prototype of the Gloster Meteor, then known as the F.9/40, first flew with two of these engines, as also did the Lockheed P-80, later named Shooting Star. Experience gained in the Rapier and Dagger, and ultimately the Sabre, with the single-sided impeller in the supercharger, was turned to good account in the Goblin compressor. The Ghost, a larger edition of the Goblin, was designed in 1945. This engine continues in production. Fitted to a modified Vampire it achieved a world's altitude record in 1948 of 59,446ft.

During the early part of the war Halford also undertook the design and development of de Havilland propellers. In the relatively short period of two years the contra-rotating propellers for the Rolls-Royce Griffon and the Napier Sabre engines were made, and many new projects initiated. This effort expanded so rapidly that in 1943 Halford had to hand the work over to others.

In a brief statement it was impossible to cover adequately the pressures and demands made on Halford and his teams. That he was master of this diverse effort throughout, and imposed such force and urgency to every aspect of it, was in itself a tribute to his strength of purpose and sense of responsibility.

The war ended and one would have expected some let-up in effort. But newer and bigger engines were required and the demands of civil aircraft were beginning to be felt. In 1943 Halford joined forces with the de Havilland Aircraft Co. Ltd., but although the staff became de Havilland employees the work went on much as before. In 1944 the de Havilland Engine Co.

[*Concluded on page 186*]

An impression by F. Gordon-Crosby of a D.H.4 with the inverted engine referred to on the previous page

Flying Fords

AN AIRFIELD'S LINK WITH U.S. INDUSTRY

THE "derequisitioning" of Ford—surely one of the most agreeable air bases—is a timely reminder of Henry Ford's interest in aviation. It is commonly supposed that the airfield is named after the neighbouring Sussex village of Ford. Until 1928, however, it was called Yapton Aerodrome. It was then taken over by the Ford Motor Company and renamed. The intention was to operate a passenger service to the Continent, using Ford Trimotor aircraft. However, the company failed to obtain a certificate of airworthiness from the Air Ministry, and the project was abandoned in 1931 when the airfield became the home of Sir Alan Cobham's famous circus.

Henry Ford was one of the pioneers of aircraft manufacture. During the First World War he made a large number of Liberty engines, and in 1925 started the world's first air freight service by operating Ford-built aeroplanes on scheduled trips between Detroit and Chicago. The prototype aircraft of this scheme, the *Maiden Dearborn I*, was a Stout Mail Plane powered with a single 400 h.p. Liberty and decorated with the familiar Ford script on her fuselage. So successful was the inaugural flight that an aeroplane division of the Ford Motor Company was organized forthwith, to progress the development of a big all-metal tri-motor, together with a small "flivver" for general use. During the first year of the aircraft division's operations, over 200,000 miles were flown and more than 1,000,000 lb of freight was carried, and not a single accident occurred.

Chief technician behind the Ford Aircraft was the renowned William B. Stout, whose own company—the Stout Metal Airplane Co.—included Mr. Edsel Ford among its directors. All the interests in Bill Stout's firm were bought by Henry Ford early in August 1925, and the works at Dearborn, Michigan, were thereafter operated as a division of the Ford Motor Company. The Liberty-engined Stout Mail Plane and Stout Transport Monoplane soon gave way to the most famous Ford aeroplane of all. Known officially as the Three-Engined Monoplane, its more familiar appellation was Ford Trimotor. There were two chief models, respectively styled 4-AT (carrying 12 passengers and normally having three 300 h.p. Wright Whirlwind or Pratt & Whitney Wasp Junior engines) and the 5-AT (seating up to 15 passengers and usually powered by 425 h.p. Pratt & Whitney Wasps). By 1929 these big all-metal machines were being supplied to airlines at the rate of four per week, but output dwindled to nothing during the great depression of the early 1930s.

It was in the autumn of 1930 that Ford shipped a 4-AT and a 5-AT to Europe for general demonstration flying. *Flight* for November 14 of that year published a full description of their construction, and noted the company's intention "if experience appears to justify so doing" to manufacture the aircraft at Hooton Park, Cheshire, which was then the headquarters of the Comper Aircraft Co. Ltd. Several aircraft were assembled in Comper hangars at Hooton Park, but series production never got under way. Nevertheless, the soundness of the design is amply proven by Bill Stout's endeavours in recent years to put a modernized version back into production under the name of Bushmaster.

Ford's greatest contribution to aviation during the inter-war years was the perfection of a radio beam. U.S. Patent No. 1,937,876, applied for on May 2, 1928, and granted to the Ford Motor Company, provided for "a radio beacon . . . especially adapted for use in connection with the piloting of airplanes or other aircraft . . . which will send out a signal in a predetermined direction so that a pilot may fly on that signal and may be kept upon his course by following the signal." A refinement of this system in the form of a station-location indicator was also patented. Instruction in the use of the beam was given by Ford to commercial airline and U.S. Army pilots, and the patent was presented to industry. Since then improvements in ground-to-air communications have kept pace with other aeronautical developments, but the radio range which we use today is merely a refinement of the system originally designed by Ford engineers.

This early experience in aviation, plus his vast mass-production resources, enabled Henry Ford to make a major contribution to aircraft production during World War 2. Months before Pearl Harbour he was asked to prepare facilities for building 4,236 Pratt & Whitney R-2800 (Double Wasp) 18-cylinder radials. This order was then the largest single aero-engine contract let under the U.S. defence programme. To meet the order—which was later increased to 9,043—Ford had to build a new factory costing 37m dollars. By the time it was completed, eleven months later. the company was already producing one engine a day, and before long it reached its target of 300 per month.

At that time (1941), one of the aviation bottlenecks in the expanding defence programme was the shortage of facilities for producing magnesium alloy. At a cost of $800,000 Ford added to their vast Rouge plant a foundry for the production of such alloys. This was by far the largest magnesium-alloy foundry in the United States; it supplied the total engine requirements, 110,000 lb per month, for the Ford-built Double Wasps, and made available the remainder of its output to other vital defence industries.

Notwithstanding these great achievements, the largest of all the

The two "Flight" photographs on this page were taken in 1931. On the right are seen two of the original inhabitants of Ford Airfield

Flying Fords . . .

Ford activities during the war was the production of heavy bombers in a specially constructed plant at Willow Run, near the Ford centre of gravity in south-east Michigan. The B-24 Liberator was the product of the finest skill in aviation. It was already being produced by Consolidated-Vultee Aircraft for the Royal Air Force and the United States Army Air Corps. It was being produced at the commendable rate of one aircraft per day; but Ford promised to make one Liberator per hour. He set out to produce it in incredible quantities, applying to a highly complex mechanism the mass-production methods which had been originated in the days of the Model T. Ford were given the contract in February 1941, and they went to work with steamroller efficiency. During the remainder of the year they built the largest factory of its kind in the world, with hangars, main assembly building, manufacturing wing, powerplant, school and offices. In January 1942 the first men and machines moved in, before the floor was dry. By February many parts were being fabricated, although the far end of the plant—a mile away—had not been roofed. On April 18 the first Lib. crept along the assembly line, gathering parts every minute; this was the first of 1,140 which were produced that year. During the following year the target of one Liberator per hour was attained—enough to make the 1959 manufacturer wince! By the middle of March 1945 production had passed the 8,000 mark, and Ford had become the largest builder of four-engined bombers in the world.

To accomplish this superlative feat Henry Ford had revolutionized aircraft production. Under the duress of war, it was his company which went furthest in making complex aircraft by the quicker, more precise way of the machine. But at heart he was a pacifist. He preferred agriculture to aviation, and he would rather build tractors than bombers. He would have welcomed the fact that this year the pleasant Sussex airfield which bears his name has been returned to civilian use, after serving the Royal Air Force and the Royal Navy as a fighter station for the past 20 years.

GEORGE LANNING.

FRANK BERNARD HALFORD, 1894-1955 (continued from page 184)

Ltd. was formed with Halford as its chairman and technical director. He had given up his connection with D. Napier & Son Ltd. in 1943.

It seemed natural that the first of the new D.H. engines should be a completely redesigned range of Gipsies embodying many features common to each type. The Gipsy Major 30 of 160 h.p. was normally aspirated and had a swept volume of 6.12 litres. It was supercharged to be the Gipsy Major 50 of 200 h.p. A new six-cylinder, the Gipsy Queen 30 replaced the earlier editions of this type. The Gipsy Queen 50 was a six-cylinder, supercharged engine of 295 h.p. and its more powerful brother (or sister?) the Gipsy Queen 70, was identical apart from the fact that its propeller was geared.

In 1947 a tremendous effort was commenced in the "civilization" of the Ghost engine for the first of the de Havilland Comet jet airliners. Halford appreciated that an entirely different mentality was necessary in the development of this civil edition of what had been and was a military engine—longevity, reliability, safety, all of these were factors of dominating importance. Over 60 per cent of the engine had to be re-tailored to suit the requirements of the aircraft designer. An intensive programme of work was undertaken which included thirteen thousand hours of bench development and over 5,200 hours of flying in two modified Lancastrian aircraft and prototype Comets.

The disasters of 1954 halted the life of the Ghost in the Comet for some years though it was established that the engines could be completely exonerated from blame. Much interesting work was carried out to determine the effect of impact at high velocity on the sea, and of high gyroscopic loadings within the engine presumed to be due to a severe bunt of the aircraft. It is not generally known that the Ghost engine had almost achieved 1,000 hr between overhauls.

The concluding portion of Mr. Brodie's lecture dealt with the development of the Gyron, which has been run at thrusts in excess of 29,000 lb with reheat; the Spectre and Sprite rockets; and the Gyron Junior. Reference was also made to an unspecified application for a pair of Spectres of higher output than formerly. Speaking of the Blackburn NA.39 (two Gyron Juniors) Mr. Brodie said: "Although initially of subsonic performance this aircraft and engine hold the potential of considerably higher speed development and to that end the thrust of the engine is being constantly increased and the application of reheat will unquestionably permit it to meet the advancing need."

Of nuclear energy for aircraft propulsion the lecturer said that Halford had tilled the ground and planted the seed. Who knew what would come forth? The many research facilities which Halford found essential for the fulfilment of his forward thinking were established within the policies of the de Havilland company at Hatfield and called the Halford Laboratory.

Mr. Brodie's concluding sentence is quoted on page 183.

GUIDED-MISSILE LIBRARIANS

WHEN the Aslib Aeronautical Group (Librarians and Information Officers) holds its annual conference during the weekend of April 3-5, a paper will be read—in two parts—on the place of the library in a guided-missile organization. Mr. J. E. Allen, B.Sc., A.F.R.Ae.S., of A. V. Roe and Co. Ltd., will read the first part (on *The Technical Environment*); and Mr. R. A. Wall, librarian of the company's weapons research division, the second part (*The W.R.D. Library and Information Service*). Other papers will be read by Mr. R. C. Wright, librarian of the R.A.E., and Mr. R. A. Fairthorne, also of the R.A.E., on their experiences at the recent Washington conference. There is also to be discussion of a paper (which it is proposed to submit to an appropriate body) reviewing the present position and trends in aeronautical librarianship *vis à vis* the state of the industry and its prospects.

Non-librarians and non-members of the group are welcome at the conference, further information on which may be obtained from T. M. Aitchison, Esq., Divisional Librarian, English Electric Co. Ltd., The Airport, Luton, Beds. Early application is advised.

SOVIET TRANSLATIONS

SINCE 1949 many engineers and scientists have benefited from the *Translated Contents Lists of Russian Periodicals* which have been published by the Department of Scientific and Industrial Research. These have been discontinued in view of the greater scope of the *Monthly Index of Russian Accessions* published by the U.S. Library of Congress at approximately £5 7s 6d per annum. Instead, the D.S.I.R. Lending Library Unit has been entrusted with the responsibility of developing a broader Russian translating programme, as described in the January 1959 issue of the *L.L.U. Translations Bulletin*.

The Lending Library Unit has a growing collection of recent Russian scientific and technological literature and, they say, "despite its imperfections, it is already the largest in Western Europe, and in science at least is now comparable in current material with that of the Library of Congress. At the time of writing (November 1958) more than 290 periodicals are being regularly received from the U.S.S.R. and we have catalogued over 7,000 Russian books. Lists of Russian literature which have been received are being issued, and this literature is available on loan to organizations who are approved borrowers from the Science Museum Library." The *L.L.U. Translations Bulletin* is available from Her Majesty's Stationery Office, P.O. Box 569, London, S.E.1, at a price of 4s (postage 5d) or at an annual subscription rate, including postage, of £2 13s 0d. Enquiries concerning it should be addressed to D.S.I.R. Lending Library Unit, 20 Chester Terrace, London N.W.1.

RETROSPECT

From "Flight" of February 6, 1909

Stolfa Cylindrical Aeroplane: In Vienna, an engineer named Stolfa has constructed an aeroplane having cylindrical surfaces instead of the usual cambered planes. The idea is apparently to assist in maintaining constancy of lifting effort, irrespective of balance, or to take an extreme case, the machine should fly as well upside down as the right way up. This might, we should imagine, be very unpleasant for the pilot unless he is already an acrobat by training, and therefore used to inverted postures. The machine weighs 250 kilogs, and trials are expected to take place with it next month.

The Ramel Pendulum Seat: Another ingenious idea which, curiously enough, seems to have an appropriate coincidence in its appearance with the above-mentioned machine, is attributed to M. Ramel, a Frenchman, who has devised a pendulum seat for his aeroplane, so that he can always sit upright irrespective of the movements of the aeroplane itself.

These two extreme cases, in the first of which the intrepid aviator has, so to speak, nailed his flag to the mast and intends to fly in any position, irrespective of personal discomfort, and the other inventor whose great idea seems to disassociate himself from the antics of his machine, are, taken in conjunction, really rather humorous, although of course both have a serious side, as either may bring out an hitherto unsuspected point which may be of service to investigators of flight.

Rolls-Royce Reversers

THRUST REVERSAL FOR JET AIRCRAFT: AN R.Ae.S. LECTURE

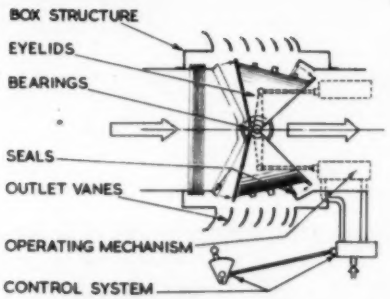


Fig. 1. General layout of Rolls-Royce reverser

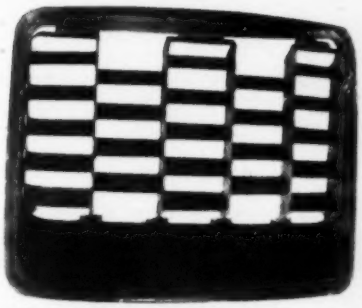


Fig. 2. Production-type vane-box

A COMPREHENSIVE account of the evolution of the current pattern of thrust reverser developed by Rolls-Royce Ltd. was given in a paper read recently before the Derby Branch of the Royal Aeronautical Society. The author was Mr. R. H. Colley, assistant chief designer of the Rolls-Royce Aero-Engine Division.

His paper began by outlining the pros and cons of thrust reverse, showing its tremendous value, particularly on wet or icy runways. In practice it was considered that the achievement of about 50 per cent reverse thrust was feasible. Mr. Colley described the various configurations of reverser which were investigated by his company, and Fig. 1 shows in diagrammatic form the principle finally adopted. Two swinging doors are so arranged that they normally seal off large ports in the walls of the jet-pipe but, for thrust reversal, can be swung round on pivots to seal the normal jet nozzle and open the side ports. Outside the latter are cascades of outlet vanes which discharge the gas in a forwards direction.

In Fig. 1 the reverser is depicted in the act of swinging from forward to reverse thrust. The door hinge axis lies on the centre-line of the jet-pipe, so that the main gas load acts in line with the hinge. Nevertheless the achievement of minimum weight was no easy task, and design problems were arduous.

In view of the fact that Rolls-Royce commercial jets have thrusts ranging from 10,500 to 18,500 lb, it is apparent that the reverser structure is very heavily loaded, and the structural design is complicated by the necessity for the large lateral outlets. The production assembly is fabricated by welding Nimonic sheet. A typical vane-box assembly is shown in Fig. 2. After considerable development these units are now made from single skins of relatively thick sheet, the vanes themselves being staggered so that differential expansion can be accommodated by slight waving of the support struts. Expansion and contraction of the latter is permitted by the hinged links at one end (Fig. 3).

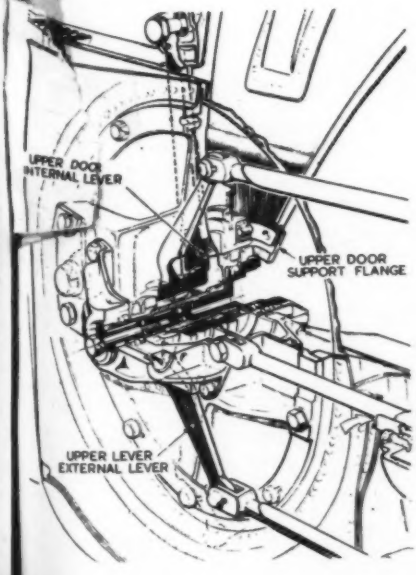
To avoid differential-expansion problems each eyelid is fabricated from a single sheet, and the top-hat stiffeners are heated by allowing a steady flow of exhaust gas to circulate through them and leak overboard through the outlet vanes. Faces on the front and rear door edges abut against sealing strips in the box structure, the forward seal being mounted on a bellows. The sealing edges in production reversers are of machined steel.

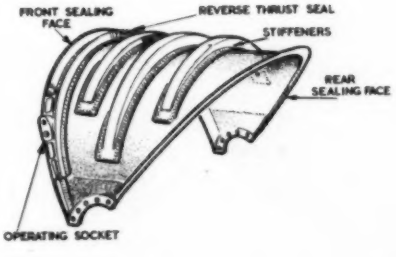
Probably the most difficult problem of all concerned the design of the door bearing. To reduce complication it was decided to employ dry bearings, operating without lubrication or cooling at the bright-red temperature of 600 deg C. Plain bearings produced high friction, and the final design comprises inner and outer races of Nimonic material with tool-steel rollers. A test bearing was run hot for nearly 6,000 operations under loads of up to 2,000 lb, and at the end of this period the diametral wear was less than 0.0001in and the friction had actually decreased by some 20 per cent. A typical Avon-reverser bearing is depicted in Fig. 4. Door-actuating torque is transmitted by sleeves quite separate from those upon which the doors are mounted.

The next section of Mr. Colley's paper described the actuating mechanism. The rams operate through a favourable leverage, in order to exert a high load on the eyelids even during high-altitude cruising when available operating pressure is low. As in Rolls-Royce reheat systems, the rams are actuated by air tapped from the engine compressor. The rams are produced by Dunlop and incorporate carbon seals and mechanical locking to prevent inadvertent operation. The selector valves and pilot's controls provide a foolproof system, in which no single undetectable failure—nor inadvertent selection due to pilot error—can result in thrust reversal. On the Comet the outboard power levers (the inboard engines are non-reversible) have their top handles so arranged that they can be easily lifted into reverse only at the flight-idling setting. In the case of the Boeing, each of the four main power levers is provided with a subsidiary lever which is in convenient reach of the pilot only when the main levers are at idling and which is in any case interlocked to provide positive safety. Once reverse has been selected a balking stop is provided in the control system to prevent acceleration of the engines; this stop is automatically withdrawn when the reverser has gone into the full reverse position.

In the final section of his paper Mr. Colley outlined the tremendous programme of rig and flight testing which has been done at Hucknall. Numerous rigs have been operated in heated boxes to assist in the development of the actuating systems, and aerodynamic behaviour has been investigated during tunnel testing. It had to be shown that dangerous temperatures cannot be reached in the neighbourhood of the main-wheel tyres, and that a minimum of gas is re-ingested into the intake.

The final illustrations depicted thrust reversers in virtually standard production form. The reverser for the Comet (Fig. 5) has outlet ducts shaped to suit the nacelle contours, and visible features include the operating rams and linkage, the switches which operate the balking system and warning light, and the heat-insulation blanket. The Conway reverser for the Boeing 707-420 had at the time of writing completed over 1,000 cycles in almost 500 hr of running; Avon reversers had operated over 5,000 cycles, during more than 1,000 hr running and some 150 hr flying.





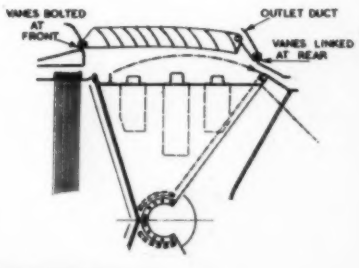
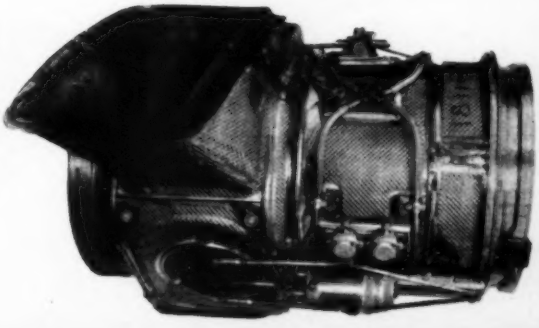


Fig. 3 (above and above right). Details of the door design and vane attachments

Fig. 4 (left). Bearing design used in the reverser for the Civil Avon

Fig. 5 (right). A Comet (Civil Avon) reverser built up ready for installation



LAST week we recorded the first flight of the first Vangard turboprop airliner to leave the production line at the plant of Vickers-Armstrongs (Aircraft) Ltd., Weybridge. Minor mechanical difficulties and exceptionally adverse weather had conspired to delay the flight and prevent the taking of first-class photographs; but a few days later it became evident that the flight-test programme was progressing smoothly (as these new pictures imply) and that the Vanguard was already giving every promise of proving an eminently successful aeroplane.

As earlier reported, G-AOYW's initial venture into her true element, on January 20, was to have been a short hop from the restricted factory airfield of Weybridge to the main flight-test base at Wisley, but the chief test pilot, Jock Bryce, decided to prolong the flight to a total of 17 min. Once established at Wisley, the aircraft was given a wooden false floor on which were mounted six complete auto-observer panels. Beneath the floor were water ballast tanks for shifting the centre of gravity. Some of this equipment can be seen in the interior photograph opposite. In the foreground is the front face of No. 7 auto observer (electrics panel), which is used to record power generation, load and frequency stability, number of operations of actuators and motors, and hours run, together with operating currents and voltages. Beyond the electrics panel is the air conditioning and de-icing panel (No. 5) which records operating temperatures and pressures throughout the two systems.

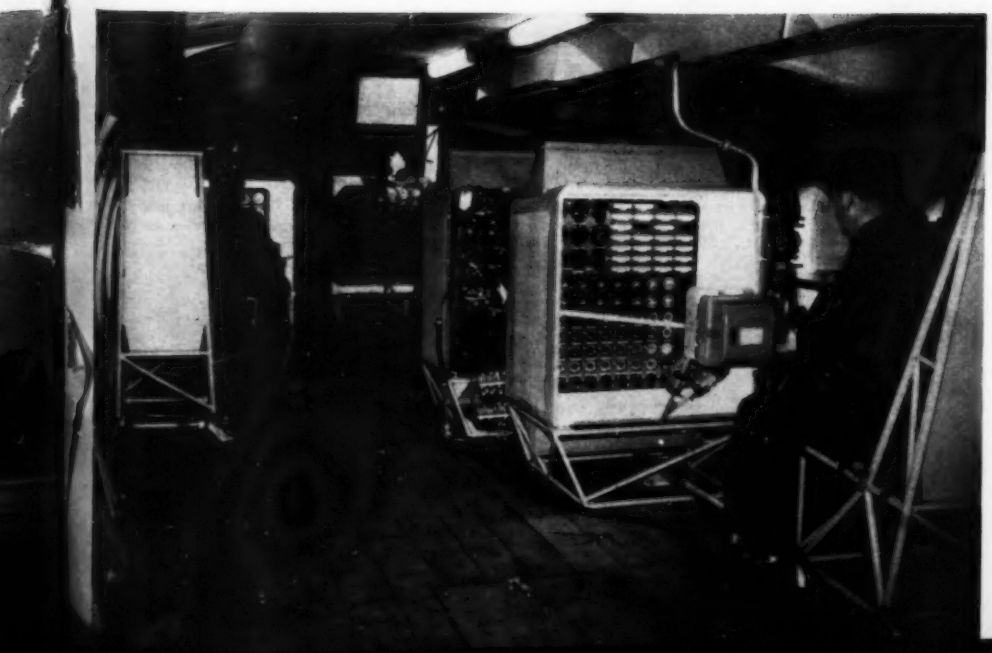
FLIGHT-TESTING THE VANGUARD

The large crate in the centre background contains (top) the handling panel, No. 2, which records true airspeed, true altitude and attitude, and control-surface angles and loads. Below it is No. 1 panel, providing key information (e.g., torquemeter readings, compressor r.p.m., speed, height and temperature) required in evaluating any other part of the aircraft systems. Observer No. 6 (left background) is the engine-bay cooling and electrical cooling panel, upon which are recorded the pressures, temperatures and flows of the various air systems.

During the first nine days of the programme G-AOYW made eight flights. The longest was the fifth, a two-hour sortie in the course of which the accompanying photographs were secured from a Viscount. By January 28 total flight time amounted to 10 hr 45 min, and the excellent serviceability of the aircraft and its 5,000 h.p. Rolls-Royce Tyne engines is emphasized by the fact that three flights were made on that date alone. Vickers state that "to the outside observer the Vanguard is impressively quiet both at take-off and in the circuit. The pilots are more than enthusiastic about the low noise-level in the cockpit, and the very fine visibility is already proving of great value."

All six pilots assigned to the test programme have already flown the aircraft: they are Jock Bryce, Brian Trubshaw, Bill Aston, Dickie Rymer, "Staff" Harris and W. D. Jarvis. The other Vickers personnel who have flown in the aircraft are the flight-test manager, Joe Leach, and seven observers: Roy Holland, Mike Crisp, Chris Mullen, Dick Wright, Pete Francis, Ron McFie and Derek Marshall.

VICKERS



G-APDC taxying in at Calcutta Dum Dum past a familiar scene: runway-strengthening and lengthening in progress for the bigger jets. B.O.A.C.'s Comet 4s have no airfield limitations at eastern-route airports today, with the exceptions only of Colombo and Kuala Lumpur

Background to a B.O.A.C. Comet 4 Proving Flight to Tokyo: Medium-jet Opportunities

THIS is the first of two articles on the forthcoming introduction of Comet 4s on B.O.A.C.'s routes to the Far East. In it are discussed the commercial implications of the new jet services; the subsequent article, to be published next week, will deal with the operational aspects

EASTERN ROUTES JET

Calcutta, January 28

ON a large hoarding prominently displayed in Chowringhee Road, near the heart of Calcutta's business and shopping area, a certain airline proclaims: "ONLY 7½ JET HOURS TO THE U.S.A."

A doubly puzzling hyperbole, firstly because the fastest 600 m.p.h. jet, flying the most direct route from West Bengal to California, would take nearly 20 hours; and secondly, because no such jet service of 7½ hours or 20 hours exists—nor is likely to do for another year.

The airline concerned could certainly not be admonished for underselling itself. But the explanation may not be too hard to find. B.O.A.C., having been the first to connect Europe with the U.S.A. by jet, will soon be the first to traverse with jets the competitive routes from Europe to the Far East. In a few weeks' time, on April 1, B.O.A.C.'s Comet 4 operations will swing eastwards as well as westwards out of London, serving the medium-distance sectors (500 miles to 2,500 st. miles) for which the aircraft was designed. B.O.A.C. will then be operating a 13,000-mile-long jet system reaching from New York via London to New York. It will, for a year at least, be more convenient for a Japanese to fly westwards instead of eastwards from Tokyo to New York.

The first B.O.A.C. eastern-routes jet terminal will be Tokyo; the next, in May, will be Hong Kong; and the next, in July, will be Singapore. By November the Corporation will be operating Comets to Australia, in pool-partnership with Qantas's Boeing 707-120s, to the farthest Antipodean terminals of its eastern-routes network.

B.O.A.C.'s traffic staff down the route do not have to prompt the remark—heard often during the first Tokyo proving and training operation, which *Flight* is accompanying—"The Comet is back." For B.O.A.C.'s competitors, Pan American, T.W.A., Swissair, K.L.M., S.A.S., Air France—and, of course, Air-India and P.I.A.—this remark provides a measure of the effect which the Comet may have on their business, assuming only that the aircraft reaffirms, as it should, B.O.A.C.'s reputation for regularity and punctuality. For perhaps a year B.O.A.C.'s rivals, with the possible exception of Pan American, can match the reality of the eastern-routes Comet 4 (and Britannia) services only with piston-engined airliners. Perhaps PanAm, like B.O.A.C., will first project their Europe-terminating transatlantic jet services eastwards, and it is conceivable that they will be able to do this during the summer of 1959. But the other carriers may not have the jet capacity to spare from the North Atlantic jet *raison d'être* route until mid-1960, leaving the Comet 4—and, as from September 1959, Qantas's 707s—with a decisive competitive ascendancy in a market which some would describe as "keenly contested," and which others would say was trying to sustain too many carriers.

Examination of timetables (*Flight*, August 22, 1958) has shown that there are nearly as many airlines chasing the traffic between Europe and the Far East as there are carriers operating the N. Atlantic between Europe and North America. The comparative thin-spreading of the Europe-Far East business compared with the N. Atlantic—which itself is generally regarded as having too many carriers—is evident from the following table:

Route	No. of carriers	Return flights per week	Return seats per week	Average passengers per flight*
North Atlantic ...	14	217	13,300	29
Europe-Middle East ...	19	162	9,100	19
Middle East-India ...	12	68	4,000	32
India-S.E. Asia ...	11	60	3,500	35
S.E. Asia-Far East ...	10	45	2,650	38

* A hypothetical figure assuming that 65 per cent of all seats offered are sold. Note: Figures are based on an average 1957-58 week.

Though loads per service—taking the operators as a whole—would appear to be rather better on the eastern routes than on the N. Atlantic, there appears to be no strong case for each carrier increasing the unit capacity of his aircraft. When one talks in these terms with B.O.A.C.'s traffic staff down the route the economics of their new airliner are expounded in this sort of way:

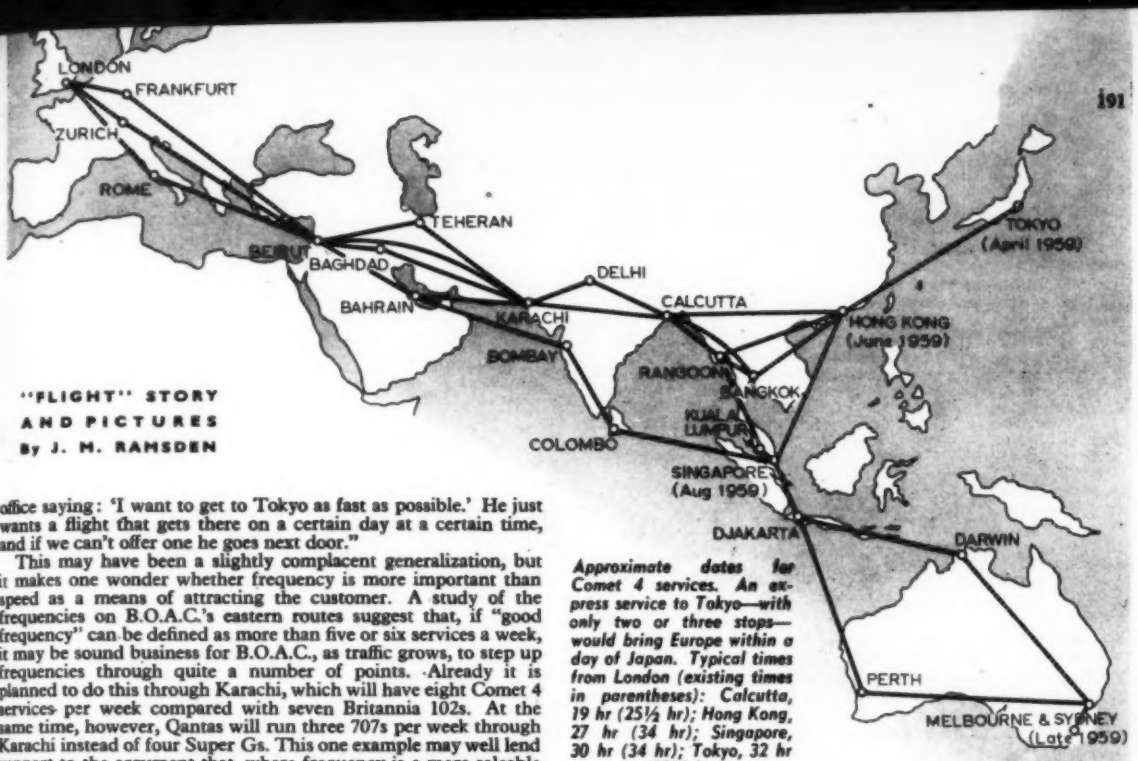
"The Comet 4 will have roughly the same seating configuration as our Britannia 102s—20 first class and 43 tourist—and it will take over operations at about the same frequencies. It should, therefore, not be difficult to achieve good load factors. Traffic-growth on our sectors has been reasonably good this last year—5 to 15 per cent, depending on the route—and Qantas believe that there will be no trouble in filling their 120-seat 707s. But we would not like the job of filling all the big jets which will be operated on this route."

At Karachi the B.O.A.C. manager simply said: "The Comet will be the right size for a long time to come." And at Delhi a senior airline manager said that no one in India would be surprised if Air-India decided to buy Comets: the only problem, he thought, was their need to get a good price for their Super Gs.

The remark "We do not know how they are going to fill them" is not just a smug justification for having bought a smaller airliner than everyone else: it is something one hears said by B.O.A.C. station staff who may not be experts in the economics of airliner size, but who nevertheless seem to have the realities of their own particular market areas pretty well sized up.

Around a coffee table in Calcutta someone asked a local B.O.A.C. official, an Indian, whether the Comet would withstand the competition of the 75-85 m.p.h. faster Boeing 707 and DC-8 a year or so hence. The answer, rather surprisingly, was a confident affirmative. "No one," he explained, "ever rushes into our

The Comet 4 at Istanbul Yesilkoy (left) and Teheran Mehrabad (right). For both airports the Comet's visit was the first by a jet airliner



Approximate dates for Comet 4 services. An express service to Tokyo—with only two or three stops—would bring Europe within a day of Japan. Typical times from London (existing times in parentheses): Calcutta, 19 hr (25½ hr); Hong Kong, 27 hr (34 hr); Singapore, 30 hr (34 hr); Tokyo, 32 hr (39½ hr)

"FLIGHT" STORY AND PICTURES
By J. M. RAMSDEN

office saying: 'I want to get to Tokyo as fast as possible.' He just wants a flight that gets there on a certain day at a certain time, and if we can't offer one he goes next door."

This may have been a slightly complacent generalization, but it makes one wonder whether frequency is more important than speed as a means of attracting the customer. A study of the frequencies on B.O.A.C.'s eastern routes suggest that, if "good frequency" can be defined as more than five or six services a week, it may be sound business for B.O.A.C., as traffic grows, to step up frequencies through quite a number of points. Already it is planned to do this through Karachi, which will have eight Comet 4 services per week compared with seven Britannia 102s. At the same time, however, Qantas will run three 707s per week through Karachi instead of four Super Gs. This one example may well lend support to the argument that, where frequency is a more saleable commodity than speed, B.O.A.C. have an airliner which the ops. planning department can re-schedule or re-route without swamping the local ticket desk with seats to the extent to which an extra DC-8 flight, in the same circumstances, might tend to do.

This Comet 4 proving flight is quite an eye-opener to those who may sometimes think of an airline route system in two-dimensional, lines-on-a-map terms; or who may imagine that the introduction of a new aircraft is relatively straightforward once crews have been trained to operate and service it. The art of scheduling alone, if not solved with precision, can easily tip the balance between profit and loss. The Comet 4 may be theoretically the right size to step up frequency without overdoing the capacity, and it may be (to give a hypothetical example) that more frequencies are needed between, say, Frankfurt and Calcutta to move more West German technicians and their families to and from the new steel mill at Rourkeld.

But the new schedule with a faster airliner could involve an extra night stop at Bangkok to avoid a night landing at Hong Kong, thus diminishing utilization of crews and aircraft (B.O.A.C.'s aim with the Comet 4 is nearly 4,000 hr per year). Or it could mean a night stop at Istanbul, where the Comet has to be expensively taxied over at 200 gal/min to the parking area after disembarkation. Or it may mean an arrival at Delhi clashing with an Air-India Super G and a Swissair DC-6B, thus swamping Dum Dum's inadequate transit lounge with 200 passengers all wanting tea at once.

And always in conflict with such practical mundanities is the need to maintain a high load factor at all seasons of the year on all sectors, so that (ideally) wherever people get off there is always a similar number ready to get on. There are, on a theoretical permutation, more than 200 pairs of points from the U.K. to the Far East between which bookings can be made with B.O.A.C.: and the problem of ensuring that no sectors have empty seats or, even worse, seats that could have been filled twice over, is one that would daunt the most commodious computer.

The lines on the B.O.A.C. map exist, and so, very soon, will trained and route-checked Comet 4 crews. But in the end the success of the operation—the third dimension—depends upon the judgment and experience of the local staff down the route. Usually one finds that the local B.O.A.C. manager is a man of some calibre in the district as well as in the British community. In Pakistan, for example, it was B.O.A.C.'s Karachi manager who received the Chief of Air Staff, Marshal of the R.A.F. Sir Dermot Boyle, when he arrived in his Canberra for the night (see picture, page 199).

The local B.O.A.C. man knows the political and commercial ins and outs of his area, and the likely effect of changes and developments on the Corporation's business. For the man at Geneva, for example, a meeting of the World Health Organization can mean a month's good business for B.O.A.C. between Zurich and the East, provided his selling is well timed and in the right quarters.

What will be the effect of the Comet 4 in terms of increased traffic on B.O.A.C.'s Eastern business? It was not the impression that B.O.A.C.'s local staff are complacent about the pulling power

Apron-strengthening at Karachi. (Below) Cabin scene en route: first-class-standard service dispensed to appreciative crews and technicians

Comet 4 crews being route-checked by Capt. R. C. Alabaster (centre), seen at Calcutta with a B.O.A.C. Indian stewardess, also under training

EASTERN ROUTES JET . . .

of the aircraft, or that they expect people to flock into the ticket offices without a push. The assistant manager at one point was trying to arrange special commodity rates for locally made razor blades to be air-freighted to the West Indies. He was also, the next day, driving 30 miles to explain to a former customer who had booked his son's May-term return to school in Europe by a rival prop-driven airliner that he was depriving the boy of B.O.A.C.'s "junior jet club" badge.

A summing-up of the Comet 4's commercial effect on B.O.A.C.'s eastern routes might be as follows:—

(1) The Comet 4 appears to be the right sort of capacity for the traffic, because it should permit traffic-growth to be handled—and indeed generated—by higher frequencies on routes which could do with them.

(2) It possesses an appeal, no less strongly felt in the East than in the West, which should be exclusive at least for the summer of 1959, and which—because perhaps the majority of people want a good service first and speed second—should hold its own against 707 and DC-8 competition.

(3) The new airliner appears to be backed by a well entrenched foreign establishment with plenty of local savoir faire, and with more local goodwill than in the Raj days of Imperial Airways, upon whose routes the present B.O.A.C. services were built.

(4) The Comet is no novelty in the East, but its return to the route gives B.O.A.C. a kind of superior caste in parts of the world where such things are no less commercially important than they are elsewhere. It is good business to be able to advertise at the top of the leader page of a paper like *The Statesman*: B.O.A.C. PROUDLY INTRODUCES THE COMET 4 THROUGH CALCUTTA, FOUR TIMES WEEKLY TO EUROPE AND LONDON, FOUR TIMES WEEKLY TO HONG KONG AND TOKYO FROM APRIL 1. There could, one feels, be more emphasis on the promotional word JET—if only to emphasize the unreality of that rival hoarding in Chowringhee Road.

Part 2 will deal with the operational aspects of the Far East Comet 4 services, including crew-training, flight-planning, navigation and airfields.

SUPERSONIC TRANSPORTS AT THE I.A.S.

Finance the Major Timing Consideration: The Sonic Boom

New York, January 30

SUPERSONIC transports, their prospects and problems, were the subject for discussion on January 29 at a morning session of the 27th annual meeting of the Institute of Aeronautical Sciences in New York. Spokesmen for engine manufacturers and airlines commented on papers delivered by representatives of Convair, Boeing and Douglas dealing with design, operation and market problems of supersonic airliners. A more detailed review of the papers will be published in subsequent issues.

Convair's engineering vice-president, R. C. Sebold, said that Convair could start a Mach 2.0 transport programme today, but they felt that the market was too small to justify the effort. On the other hand, a Mach 3 or Mach 5 airliner should prove attractive to airline management because it would offer improved operating costs, an economic life of 15-20 years, and be available at about the time when airlines would be able to afford it. Convair studies showed that a Mach 3 machine would have 12 per cent lower operating cost per seat mile than a subsonic jet if both were operated at their design range. Transatlantic flight times of 2-2½ hr should appeal to passengers, Mr. Sebold believed. Convair estimate that a Mach 3 transport could be operational in 1970.

Basic aircraft design will be strongly influenced by supersonic boom phenomena. Dimitrius Gerdan, engineering director for Allison, pointed out that NASA scientists claim that a Mach 3 aircraft at 70,000ft caused an audible boom swath on the ground over 200 miles wide. At altitudes below 30,000ft window damage was almost assured. In order to avoid damage to ground structures and avoid civilian complaints it would probably be necessary for a supersonic transport to climb subsonically to about 35,000ft before passing Mach 1. Only above this altitude could it accelerate to its design cruising speed. Such compromises in flight path would effect not only operations but design as well. Douglas engineering vice-president E. F. Burton, and Dr. V. V. Holmes, also of Douglas, noted that nearly one-third of the total fuel may be consumed in climbing to 20-25,000ft.

Fuel costs would assume an increasingly larger share of operating costs, and flight planning and fuel scheduling would be of even greater importance than they were for subsonic jets. Maynard L. Pennell, Boeing Transport Division chief engineer, said that the possibility of a decompression or engine failure that could force the transport to lower, less efficient, altitudes than 65-75,000ft, resulted in a wide region of "point of no return." For this reason, considerations of emergencies would be the critical fuel planning requirement.

Thermal problems at Mach 3 might require that the fuselage be jacketed with water for cooling. This concept was viewed unfavourably by Birger Holmer of S.A.S. who felt it would create undue problems for airlines that operated in arctic regions. Convair also suggested that in the interest of structural economy it might be desirable to eliminate passenger windows entirely. Since Mach 3 introduced many unfamiliar problems, Raymond D. Kelley, technical development superintendent for United Air Lines, advised that manufacturers should not overlook the Mach 2 transport.

Whether the supersonic transport cruised at Mach 2 or Mach 3, both General Electric and Pratt and Whitney believed that the necessary engines would be developed with military support, but that technologically there was no problem.

Financial, rather than technological, problems would delay the introduction of supersonic transports until 1972-75, according to Douglas. Besides having to pay for a large commitment of long-range subsonic jets, the airlines were expected to enter a wave of buying medium-range subsonic jets in 1963-1964 that will further postpone plans to buy supersonic equipment. It appeared, therefore, that technology must await the airlines' ability to buy, and that by the time the customer was able to buy, the manufacturers would be able to deliver Mach 3, rather than Mach 1.5 or Mach 2, aircraft.

Because the productivity of a Mach 3 transport was nearly four times as great as for a subsonic jet, fewer supersonic aircraft would be required to handle a given amount of traffic, resulting in a market of relatively few units. Costs for manufacturing facilities and development of a supersonic transport might approach $1 billion (compared with $300 million for the DC-8), or almost $10 million per aircraft for an anticipated market of 100 aircraft. Manufacturing costs might be in the order of $15-20 million each, so the sales price might be a startling $25-30 million. It would be necessary for traffic to expand the number of units required, or for the Government to support development, to bring the price down to $20 million each. At this price the supersonic transports, Douglas believed, could be economically sound airline investments.

Utilization of Mach 3 transports was subjected to much debate. While manufacturer operating cost estimates were based on 2,500-3,000 hr annually, airline spokesmen tended to feel that practical considerations would reduce this. Pan American's S. B. Kauffman, assistant vice-president engineering, indicated that their experience would indicate that utilizations of about 6 hr per day could be expected. Mr. Holmer anticipated that such human factors as reluctance to lose a night's sleep on eastward flights would compromise scheduling and utilization. Boeing, viewing the successful PanAm-National operation of using the same 707s on transatlantic and New York - Miami runs, thought that this approach could be used elsewhere as well to maintain high utilization. Mr. A. O. Baltensweiler, Swissair vice-president, suggested that fare differentials might be necessary to boost night flying and maintain high use.

It was M. G. ("Dan") Beard, of American Airlines, who cautioned manufacturers to remember the passenger. Reduction in travel time would not be the only new experience for air travellers. Steep floor angles during climb, possible use of afterburners, and seeing the world from 60,000ft would be something a person had to get accustomed to. These factors plus the prospect of no windows and inconvenient departure and arrival times were all human problems to be considered.

As Dr. V. V. Holmes of Douglas commented, airlines and manufacturers would approach the supersonic airliner with caution. But M. G. Beard best summed up the prospects for such aircraft when he said: "The speed potentials of this vehicle will keep us driving until it is an operating fact."

PETER E. VIEMEISTER.

Duck-billed platypus: Convair proposal for a Mach 2 to 5 transport

Straight and Level

A NATION-WIDE competition is being launched by the Art League of the British Empire for a sculpture symbolizing "Material Diversion." This phrase is well known to all sections of British air transport, but it is understood by no one. I quote from the appropriate Ministerial decree, which says that a new scheduled service must be "of such a nature as to generate a new class of passenger traffic without material diversion from the 'normal scheduled services' of any other previously approved U.K. operator."

The winner will be fascinating, because the subject lends itself well to abstract art forms. Straight and Level's art department is to enter a huge bronze impression of the 1949 Air Corporations Act, covered with mildew, cobwebs and dust, and with holes shot through it from cover to cover.

● Ever since the Prime Minister of Canada, Mr. John Diefenbaker, made his carefully worded statement on defence on September 23 I have been wishing I had kept a tally on the number of times it has been reported in the Press that the Avro Arrow has been cancelled. I am sure that by now the total must have passed one hundred. All very fine, of course, except for the fact that the Arrow has NOT been cancelled.

What was originally said was: "The development programme for the Arrow aircraft and the Iroquois engine should be continued until next March, when the situation will be reviewed again in the light of all existing circumstances at that time."

It is particularly worth noting that the programme actually accelerated steadily throughout 1958, and it is probable that the cost per day is now higher than at any previous time. The Canadian Government's willingness to bear this cost is surely proof of their sincerity, yet from one end of Canada to the other people are saying: "What's that?—they *haven't* cancelled the Arrow? . . . Oh well, they're going to, of course."

● Cor strike a light! What a turn-up for the book!

Quote from a U.S. journal, November 1958: "Although the British tried to evoke interest [by Western Germany] in their P.1B [Lightning], it was ruled out of court by the unnecessary complexity of its two engines."

Quote from a Swiss journal, January 1959, explaining the German choice of the F-104: "The . . . would have been too heavy and too costly for the given task. The English Electric P.1B Lightning likewise, since it is a twin-jet model."

View expressed to R. Bacon by an American engineer (from Republic Aviation): "I cannot understand why you British don't like a single engine. I can *prove* that the single-engine configuration is better."

Quote from *Aviation Week*, New York, January 19: "Air Force in the future will not procure fighters with less than two engines. Better probability of survival and more reliability offered by multi-engined designs are considered essential because of the high cost and performance of upcoming designs. Same policy is favored by Navy."

Oh, well. . . .

● "It is far easier," says Mr. John Watkins, T.A.A.'s director of engineering, "to fill a Viscount at £10 8s from Melbourne to Sydney than to fill a DC-4 at £7 10s."

For the protagonists of the fare-differential that's a pretty significant remark. It isn't just an opinion—it's a hard fact, put on record by one of the airline industry's most respected executives. It means that at least some airline markets are more elastic to quality of service than to fare-levels; and if the jet/turboprop "quality-ratio" is agreed to be about the same as the Viscount/DC-4 quality-ratio, the jet operators have little to fear from a jet *v.* propeller fare-differential.

● *"This preoccupation with new models was one reason for poor financial results. For one thing, quite promising models were not necessarily in production long enough to recover all their initial costs."*

These words were used of a leading British motor manufacturer over 25 years ago—and might equally well be applied today to one or two aircraft manufacturers I could name. Perhaps cars *and* aeroplanes provide evidence to support the theory of the "managerial revolution"—that some businessmen put their own wishes before those of their shareholders, public or private.

Famed Top Brass Nix Hi Flite

From my U.S. staff, to whom English is a living language, comes this account of how plans for Operation Hi Flite were progressing as Straight and Level went to press:—

The mission commander was doing a compilation of the mission termination destination configuration which would provide the aircraft commander with a predictable safetification based on environmental data predicated by a weather activity. The capability to abort prior to the termination of the subject part of the mission was a must.

The airplane to be used is a famed bomb ship in which the most famed aviators had gotten their acedoms after finalization of two activated mission postures from Finchley Field of the Britishers aircorps in England London.

Veteran commander of the famed 10007th Bomb Wing talked about the competent evaluatory exercise needed to put the Finchley airbase into an operational mission posture situation.

When the airplanes reached England London they would terminate the mission by landing at the new airbase. To integrate the inhabitants of the quaint old village of Finchley with their situation the City Hall would be invited to a Bar-B-Q at which York Pudding, Fish 'n' Chips and American Tea would be dispensed by Airmen 2nd Class dressed as Beefeaters. After the chow a citation was slated to be retropresented to the Mayor.

● Vickers have just sent me a cutting from a Teheran newspaper which says that "the 880 could offer coach accommodation for 510 passengers . . ." Vickers' comment is "So *that's* how you make the medium jet profitable."

ROGER BACON

The steps of the Paris Opera would seem to be an odd place to find an Emeraude—or a car, for that matter. Explanation: they were prizes to be won at the "gala appearance of famous Greco-Italian singer La Callas"

Dart Overhaul by B.E.A.

PILOT SCHEME AT L.A.P. ENGINEERING BASE

NEW facilities for the complete overhaul and testing of Rolls-Royce Dart turboprops have recently been brought into use by British European Airways at London Airport at a cost of about £300,000. This is the first time that a U.K. airline has undertaken the complete overhaul of this type of engine.

At present B.E.A. are carrying out this work on Dart 506s on an experimental scale in an engine overhaul and test shop forming part of the existing engineering base. On completion of the new engineering hangars and shops now under construction, more extensive overhaul facilities and two additional test plants will be installed there, and Dart 510s and 520s will also be handled.

Dart overhaul by the Corporation means the elimination of the time and cost of road transit of engines to Rolls-Royce at Derby, and a considerable reduction in the number of spare engines required by B.E.A. With more than 250 Darts in service, the airline now claims to have more gas turbines in use than any other civil operator.

Under the new scheme, engines coming out of service are received at the engineering base, where they are reduced to their sub-assemblies which are in turn dismantled. The special tools required for this work are mounted on panels close to the individual operations, and dismantled parts are then passed on to the cleaning bay.

Most of the machines in the salvage or re-work section are of general-purpose type, but in some cases are fitted with special fixtures and equipment. Stands of special design are used for dismantling and re-building of engines to and from their sub-assemblies. These are provided with power rotation about the lateral axis and can be manually rotated about the longitudinal axis. This affords maximum accessibility and enables the engineers to position the work comfortably for their purposes.

When the overhauled engines are completely assembled they are subjected to a rigorous test schedule. To save space the engine test plant has been placed in an underground cell and care has been taken to ensure that the minimum of time is needed to change from one engine to another.

The method adopted by B.E.A. in collaboration with Heenan and Froude Ltd. of Worcester, who designed, built and installed the test plant, has been to provide two engine carts, one of which may be in use on the test bed while the other is in the overhaul shop above having an engine fitted to it. By this means the necessary electrical harness, piping, adaptors and the like can be fitted to an engine before it enters the test cell, and while the plant below is testing another engine.

Outrigger guides are provided on the test-cart sling to protect the engine from damage during descent to the test chamber. A sliding door, motorized to open and close horizontally, covers the entrance to the cell, and sound-proofing has been achieved by lowering the door on to thick felt pads.

The engine test cell with Dart 506 installed. From the left are (1) Heenan dynamometer, (2) cardan shaft guard tube, (3) engine test cart and base plate, and (4) accessory trolley carrying extension exhaust pipe and Froude water brake

The underground installation is divided into two compartments; the single test cell and the control room. When the engine cart is lowered into position it is automatically located by dowels, the pipe connections on the cart automatically engaging with matching self-sealing connections on the base plate. All pipe connections for oil, water/methanol and fuel are thus made instantaneously and without effort.

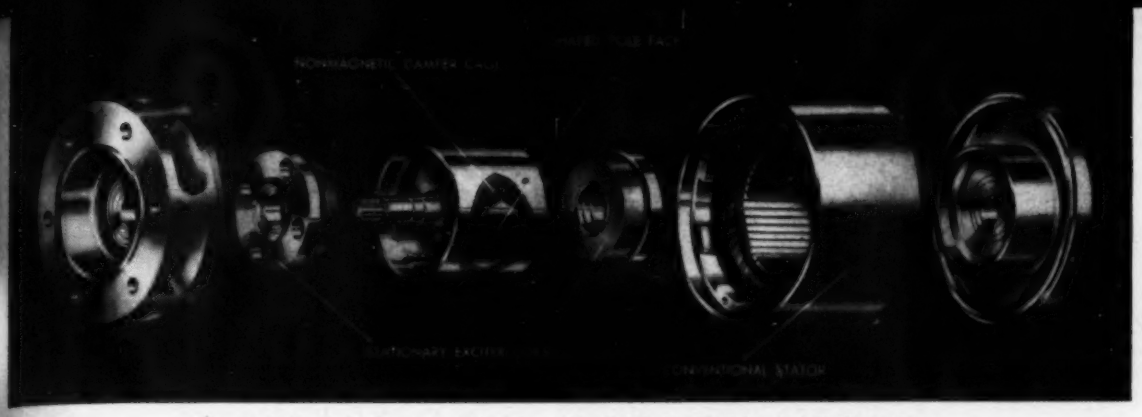
After the engine cart is locked in position the Dart propeller shaft is coupled to a tubular cardan shaft, connecting it to a Heenan-Dynamatic Mk 6 CA dynamometer capable of absorbing and measuring up to 2,500 b.h.p. The necessary loading of the accessory drive of the engine is achieved by means of a small Froude hydraulic dynamometer carried on an accessory trolley. A good view of the test bed is obtained through the observation window of the control room, and observation of the far side of the engine is by means of a large mirror mounted on the remote wall of the cell.

The engine's fuel consumption can be read from gauges sited behind glass, but no fuel pipes run through the control room. Safety precautions are good throughout the plant: exhaust gases are taken through a sound-proofed uptake to the roof of the building and discharged to atmosphere, and electro-pneumatic rams are provided to operate the shutters of the main air intake as a fire precaution measure, in addition to carbon-dioxide and water spray equipment. The floor trenches are continuously scavenged to remove fumes by means of ducting and a separate fan. This extraction system is interlocked to prevent fuel being supplied for testing until scavenging has been operating for 20 min from a shut-down condition. The main fuel tanks are located outside the building.

A considerable number of engines have already passed through B.E.A.'s Dart overhaul shop. The two Heenan and Froude test beds to be incorporated in the new extension to the engineering base will be situated above-ground. In addition to testing Darts, these beds will also be capable of testing B.E.A.'s Tynes.

Control room of the Heenan and Froude underground test plant. A mirror in the cell permits observation of the far side of the engine

The sub-assembly bays in the overhaul shop are each equipped for a particular series of operations. Note racks and mobile stands



The simplicity of the Secsyn is evident from this slightly idealized "exploded" illustration

SECSYN

AN IMPROVED ELECTRIC SYNCHRONOUS MACHINE

SEVERAL years have now elapsed since the publication of the Bekey-Robinson patent as a legal document. During this time its principles have become familiar to only a small proportion of the world's users of electrical machinery, and even those most likely to welcome it have—not unnaturally, perhaps—been reluctant to adopt so unconventional a device. Now, however, the Bekey-Robinson patent is being exploited by Jack and Heintz Inc. of Cleveland, Ohio, one of the leading American firms in the aircraft electrical field. They are to market machines using the principle under the name Secsyn (Stationary-Exciter-Coil SYNchronous).

The Secsyn brushless generator is a salient-pole synchronous machine utilizing a conventional stator but incorporating a highly unconventional means of providing excitation to the rotating pole structure. Bekey-Robinson's design objective was to induce flux from stationary field coils into a rotating pole structure in a simple, efficient, lightweight manner. The simplest approach was to cause the field flux to link stationary excitation coils. To do so, however, necessitated auxiliary air gaps. Thus the problem was reduced to inducing field flux through the stationary excitation coils and auxiliary air gaps, without incurring a weight penalty in comparison with generators using slip-rings to supply rotating field windings.

The Rotor. A typical four-pole rotor is shown in the accompanying illustrations. The rotor is essentially a tube supported by a "spider of spokes" on the shaft. These spokes, extending from the shaft to the north poles, are of magnetic material. The north poles appear as approximately hexagonal areas on the rotor surface.

What appeared initially to be a problem in shaping the pole faces for optimum wave-form is now a basic advantage of the design. Flux distribution in the air gaps can be controlled very simply by shaping the pole faces, and the near-hexagonal shape was chosen because of good wave-form results and also for manufacturing simplicity. Further development may produce even better results from other unusual shapes.

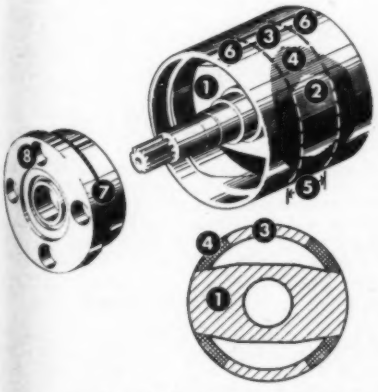
Both north poles are surrounded by non-magnetic but electrically conducting material which forms a part of the damper cage. The remainder of the central portion of the rotor tube (equivalent to the width of the north poles) forms the south pole. At each end of the rotor tube is an outer ring to provide a path for the return of flux to the stationary field coils via the homopolar air gaps. While the rotor design shown is four-pole, the machine can be built in any configuration, including two-pole.

The Flux Path. A flux is induced by each stationary exciter coil in the iron within the coil. The flux flows into the shaft axially, and then moves radially out through the magnetic spokes of the spider to the hexagonal north poles. It then continues radially across the main air gap to the stator teeth; peripherally around the stator yoke to the stator south-pole area; radially across the main air gap to the rotor south-pole area; longitudinally to the ring on each end of the rotor tube; across the homopolar air gaps to the soft-iron field yoke adjacent to the stationary exciter coils; axially into the coils; and, finally, across the homopolar air gaps into the shaft.

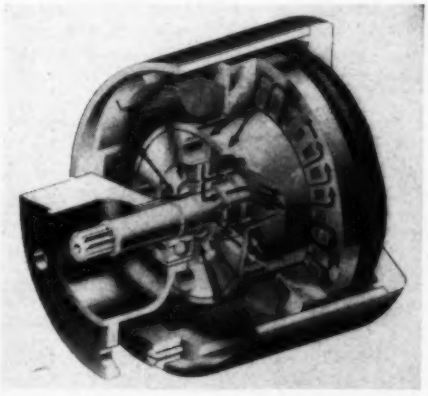
By virtue of the unique magnetic field, state Jack & Heintz, the Secsyn combines the advantage of simple brushless construction with the weight and size advantages of conventional statically excited generators—proving that the hurdle of the auxiliary air gaps has been crossed. In fact, owing to the ideal proportions of these auxiliary gaps in the Secsyn, the mmf drop across the gaps is less than 10 per cent of the total excitation ampere-turns. The bobbin-wound field coils enclose a maximum flux-carrying area with no waste copper in end-turns, and their increased ampere-turns can be produced without additional excitation wattage. Thus, while the Secsyn inherently requires greater mmf (ampere-turns), the efficient, circular field coils (with a shorter mean turn length than possible in wound-rotor construction) make excitation power requirements rather less than that of conventional machines.

Advantages. Four prime advantages, say the makers, accrue to users of the Secsyn brushless machines: long life and reliability, high operating speeds, high-temperature operation, and adaptability to any cooling method. The Secsyn machines are exhibiting a service life more than twice the conventional figure, because the design has: no brushes or rotating rectifiers; no rotating copper field windings which may have a tendency to shift, resulting in winding failures as well as unbalance and subsequent bearing failure; and no seals for coolant in the rotor. It can be designed for operation at any speed up to, and possibly beyond, 100,000 r.p.m. The machine does not suffer from operating limits imposed by brushes and rotating rectifiers, rotating copper field winding which must be mechanically braced and seals for rectifier coolant.

[Continued overleaf



1 North magnetic spoke
2 North pole
3 South-pole area
4 Non-magnetic damper cage
5 Polar zone
6 Flux-return rings
7 Stationary exciter-coil. (Locates under flux-return ring of rotor tube; does not rotate, being fixed relative to stator)
8 Coil cooling-air passages



Basic construction of the fixed and rotating portions is depicted above. On the right is a diagram illustrating the flux-paths (arrowed)

SECSYN . . .

CHARACTERISTICS OF JACK AND HEINTZ SECSYN BRUSHLESS GENERATORS

Rating (kVA)	P.F.	Speed (r.p.m.)	Frequency (c/s)	Phase	Duty	Weight (lb)	Length × o.d. (inches)	Application	Status
0.5	1.0	12,000	400	3	Cont.	3	3.0×3.0	Missile supply	Designed
0.75	1.0	24,000	800	3	5 min.	2.8	3.0×2.8	Missile supply	Designed
1	0.75	12,000	400	3	Cont.	8	3.6×4.3	Aircraft, air-cool	Built and tested
1.5	0.9	70,000	7,000	3	1 min.	1.1	2.5×2.4	Missile supply	Designed
2	1.0	12,000	400	3	1 min.	8	3.6×4.3	Missile supply	Designed
5	0.8	12,000	400	3	Cont.	25	6.8×7	Aircraft, air-cool	Built and tested
7	0.7	4,000	400	3	Cont.	30	7.0×8.5	Aircraft, air-cool	Designed
7.5	1.0	48,000	1,600	3	5 min.	8	3.8×4.3	Missile supply	Built and tested
8	0.75	8,000	400	3	Cont.	24	8.5×6.0	Aircraft, oil-cool	Designed
10	0.75	12,000	400	3	Cont.	30	9.0×7.0	Aircraft, oil-cool	Designed
20	0.75	12,000	400	3	Cont.	40	7.0×8.5	Missile supply	Designed
40	0.75	6,000	400	3	Cont.	73	11.2×11.0	Aircraft, air-cool	Designed
60	0.75	6,000	400	3	Cont.	87	11.0×11.0	Aircraft, oil-cool	Designed
90	0.75	6,000	400	3	Cont.	118	12.0×11.0	Aircraft, oil-cool	Designed
125	0.8	12,000	400	3	Cont.	190	14.0×13.5	Ground power	Designed

Operation at high temperature is facilitated, since all windings are stationary and readily cooled, and rectifiers do not have to be located in the machine. The Secsyn is adaptable to oil cooling or other special cooling techniques; all critical hot spots are stationary, no brushes or rectifiers need be protected against corrosive atmospheres and windings can be completely encapsulated for protection, yet cooling can be provided in a normal manner to avoid weight penalty.

Other Functions. While the foregoing discussions have dealt with Secsyn as an A.C. generator, the design can be used to perform a wide range of functions, with accompanying advantages listed thus by the makers:—

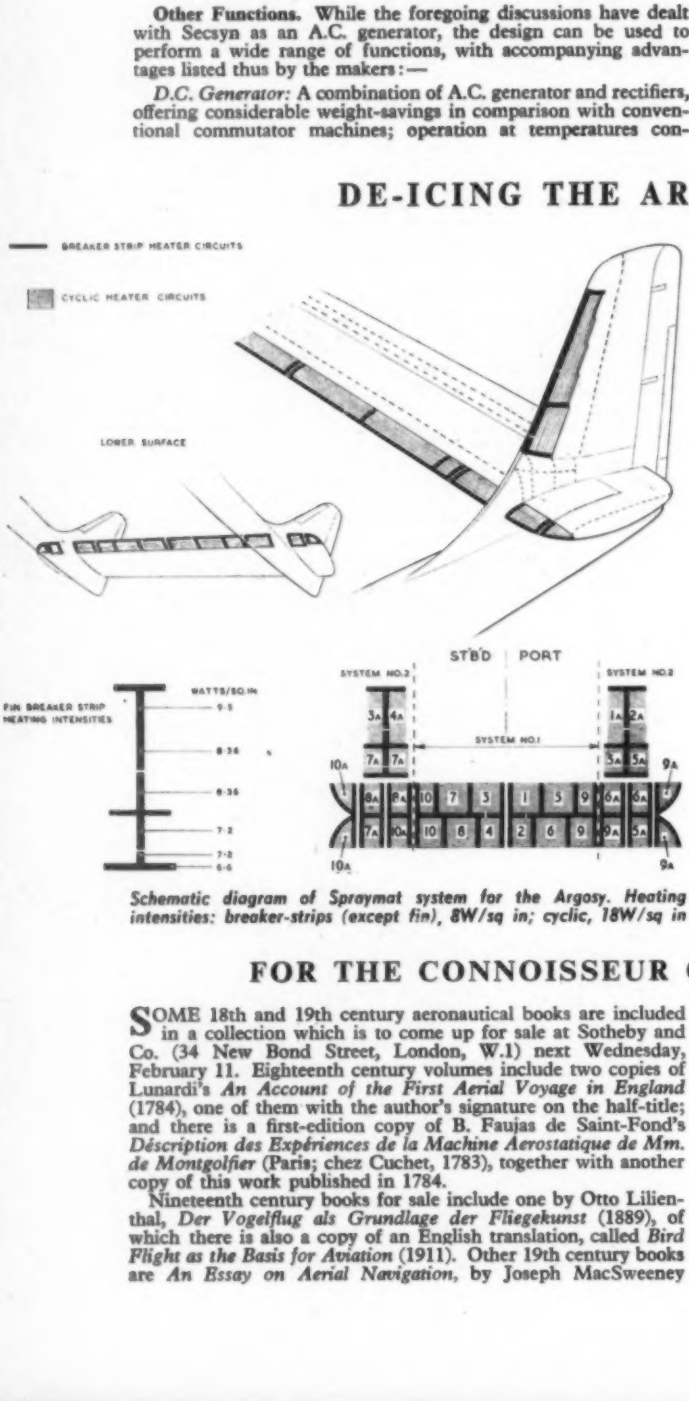
D.C. Generator: A combination of A.C. generator and rectifiers, offering considerable weight-savings in comparison with conventional commutator machines; operation at temperatures considered difficult for commutator machines; and considerably less radio noise.

Synchronous Motor: Exhibits good starting and pull-out torque and average pull-in torque, compared to a slip-ring machine. Can be applied over a wide input frequency range.

Synchros: Can be applied as a transmitter/receiver or resolver.

Constant Speed Motor: With appropriate auxiliary equipment, can hold exact speed when operated from a power supply of normal frequency tolerance.

DE-ICING THE ARGOSY'S TAIL UNIT



Schematic diagram of Spraymat system for the Argosy. Heating intensities: breaker-strips (except fin), 8W/sq in; cyclic, 18W/sq in

LIKE the majority of transports now being built in the British Commonwealth the Armstrong Whitworth Argosy incorporates electro-thermal de-icing elements of the sprayed-on metallic Spraymat pattern produced at Luton by D. Napier and Son Ltd. As the installation is one of particular importance it is appropriate to describe it in some detail. (The Argosy itself was fully described in *Flight* of October 17 last. De-icing of the mainplane is accomplished by air heated in exhaust-gas heat exchangers.)

The heaters are arranged in two independent systems, one covering the middle 23ft 5in of the leading edge of the tailplane, and the other protecting the leading edges of both fins, the elevator horn-balances and the remainder of the tailplane inboard and outboard of each fin. Aggregate protected areas add up to totals of 42.6 sq ft for System No. 1 and 45.14 sq ft for System No. 2.

Each system consists of continuously heated leading-edge and chordwise breaker strips separating 10 cyclically-heated areas. Two 10-way, three-phase cycle switches are installed, one in the root of each fin. The port-side switch controls the cyclic circuits of No. 1 system and the starboard switch those of No. 2. Power for the two systems is drawn from four alternators, one on each engine, as follows:—

System	Alternator	
	Normal	Emergency
No. 1 continuous	4	1
No. 1 cyclic	1	4
No. 2 continuous	2	3
No. 2 cyclic	3	2

Power consumption: No. 1 system, continuous: 4.8 kW; No. 1 system, cyclic, from 9.9 kW min. to 10.1 max.; No. 2 system, continuous, 7.1 kW; No. 2 system, cyclic, from 9.9 kW min. to 10.4 max.

Heating intensities on the continuous and cyclic circuits are 8 watts/sq in and 18 watts/sq in respectively, except on the continuously heated fin leading-edge and chordwise breaker strips, where the heating intensity varies in three steps from 6.6 watts/sq in at the roots to 9.5 watts/sq in at the tips.

FOR THE CONNOISSEUR OF AVIATION LITERATURE

SOME 18th and 19th century aeronautical books are included in a collection which is to come up for sale at Sotheby and Co. (34 New Bond Street, London, W.1) next Wednesday, February 11. Eighteenth century volumes include two copies of Lunardi's *An Account of the First Aerial Voyage in England* (1784), one of them with the author's signature on the half-title; and there is a first-edition copy of B. Faujas de Saint-Fond's *Déscription des Expériences de la Machine Aerostatique de Mm. de Montgolfier* (Paris; chez Cuchet, 1783), together with another copy of this work published in 1784.

Nineteenth century books for sale include one by Otto Lilienthal, *Der Vogelflug als Grundlage der Fliegekunst* (1889), of which there is also a copy of an English translation, called *Bird Flight as the Basis for Aviation* (1911). Other 19th century books are *An Essay on Aerial Navigation*, by Joseph MacSweeney (1844); *Travels in the Air*, by James Glaisher (1871) and *Experiments in Aerodynamics*, by S. P. Langley (1891).

Among the 20th century titles offered are *My Airships*, by Alberto Santos-Dumont, and *The History of Aeronautics in Great Britain*, by J. E. Hodgson (limited edition; plates; Oxford, 1924). There is also a first volume of *Flight* (January to December, 1909).

TAKING A CAR ABROAD

MOTORISTS about to plan holiday tours abroad will find a great deal of helpful information in today's issue of our associated journal *The Autocar*, a special number entitled "Planning Your Holidays Abroad." Routes, climates, food, specialized services available and foreign hire facilities are among the subjects covered. Price of this enlarged issue is 1s as usual.

THE INDUSTRY

Further English Electric Appointments

FOLLOWING the recent announcement of the formation of English Electric Aviation Ltd. (*Flight*, January 16) the English Electric Co. Ltd. has announced the appointments of Mr. W. Shorrock as general manager of the company's works at Preston, Lancashire, of Mr. W. Harpley as deputy general manager (works) and of Mr. T. O. Williams as aircraft manager.

The company also announces that following the appointment of Mr. F. W. Page to the Board of English Electric Aviation and as chief executive of that company's Aircraft Division, Mr. R. F. Creasey becomes director of engineering of the division with Mr. F. D. Crowe as chief engineer and Mr. A. E. Ellison as chief designer.

Further, as a result of Sir Conrad Collier's appointment as an English Electric Aviation director and also as chief executive of the company's Guided Weapons Division, Mr. L. H. Bedford becomes the division's director of engineering with Mr. G. R. Jefferson as chief engineer.

David McIntyre Prize

AT a presentation of awards to apprentices of Scottish Aviation Ltd. recently the director and chief engineer, Mr. R. McIntyre (who is president of S.A.G.A., the Scottish Aviation Guild of Apprentices), announced the initial award of the David McIntyre Memorial Prize (which went to David G. Reid) founded in memory of the company's late managing director. In his speech he reminded the apprentices that attention to detail was "absolutely vital" in the aircraft industry; many disasters had been traced to some minor oversight.

Scottish Aviation now employs a total of 350 apprentices of all grades and last year one of them, Quentin Wilson, was for the first time awarded an S.B.A.C. scholarship and is pursuing his studies at Cranfield.

Sperry De-centralization

IN what is described as "a substantial re-organization," the Sperry Gyroscope Co. Ltd. has established three separate operating divisions with the object of de-centralizing its management. Known as the Brentford, Bracknell and Industrial Divisions, each is to have its own sales, design and manufacturing facilities; while the fullest exchange of technical information and resources will continue throughout the company. Brentford will be responsible for Sperry's aeronautical activities in particular, as well as its marine and naval interests, whilst Bracknell will concentrate on Government contract work for guided weapons and inertial navigation. The Industrial Division will be responsible for the company's growing interests in industrial control engineering in its varied aspects.

Mr. Robert Broadbent

With these organizational changes the appointment has been announced of Mr. Robert Broadbent as a managing director of the company, under whose direct executive control the three divisional managers will operate. He has been a director, and general manager, for some years past.

The manager of the Brentford Division will be W/C. J. C. G. Bell, who relinquishes the position and title of sales manager but will continue to be a director of the company. Mr. R. E. Leete is appointed sales manager and Mr. C. A. Richardson retains his position as manager, aeronautical sales.

Mr. H. B Sedgfield, M.B.E., has been appointed manager of the Bracknell Division, relinquishing the position and title of engineering director but continuing to be a director of the company. A new factory has recently been built at Bracknell New Town and is rapidly coming into full operation.

Mr. M. L. Jofeh, O.B.E., who was formerly the company's chief engineer, has been appointed manager of the Industrial Division.

Advice to Apprentices

WHEN prizes were presented to Blackburn and General Aircraft apprentices at Hull Guildhall recently, the company chairman, Mr. Eric Turner, said there were now more than 400 apprentices at Brough and many more in the group's other factories. With a full programme of work at Brough, he believed that Blackburn could offer employment for many years; but whatever the future held, apprentices would be grateful for the training they got at Brough and the company would have been glad to have played a part in increasing the number of technologists and craftsmen in the country.

At the Blackburn and General Aircraft prizegiving, reported on this page: Mr. S. Scott-Hall addressing the apprentices. With him are Mr. Eric Turner (left) and Mr. N. E. Rowe

Mr. N. E. Rowe, the technical director, said that if this country was to keep pace with the U.S.A., U.S.S.R. and other nations, we must step up our training programme; and Mr. Stewart Scott-Hall, Scientific Adviser to the Air Ministry, also referred to the challenge from abroad in his speech before presenting the merit awards—telling the apprentices that the future of this country depended on their ability to meet that challenge.

The Robert Blackburn Memorial Prizes were won this year by B. Maskew (final year, £50); P. L. Snowden (3rd year, £25); J. M. Chaney (3rd year, £25); and P. Suddaby (first year, £25). The directors' prize for the best all-round craft apprentice went to M. L. Jennings, who received from Mr. T. Bancroft (production director) the traditional award of an inscribed wrist-watch.

Laminated Shims

AMONG contributors of detail parts to the Vickers Vanguard are B. Attewell & Sons Ltd. of Iver, Bucks, whose laminated shims—whether in aluminium, brass or steel—have been used for many years by leading aircraft companies. In the case of aluminium, the "peelable" laminations are of 0.002, 0.0025 or 0.003in, and sheets 18in square or 18in by 6in and of ⅛in to ¼in thicknesses are obtainable from stock. Laminated brass with leaves of 0.002in or 0.003in thickness is available in two forms, L.B.2 (metallic-bonded) and L.B.4 (plastic-bonded). Similarly in laminated steel there are two types, L.S.1 (metallic-bonded with maximum hardness) and L.S.2 (bonded with a thermosetting plastic adhesive, permitting easy peeling for quick and accurate adjustment).

B. Attewell & Sons Ltd. also manufacture Perspex tableware, (including serving trays and their accessories) and also glassware, which because of their lightness and unbreakable qualities are admirably suited for use in aircraft.

IN BRIEF

Saunders-Roe Ltd. have formed with Nuclear Enterprises (G.B.) Ltd. of Edinburgh a new jointly owned company, Saro-Nuclear Enterprises Ltd., with its head office at 53 Parliament Street, London, S.W.1. Its activities will cover the fields of applied irradiation and the application of isotopes to industrial processes.

* * *

Nine Pelapone "no-break" generating plants—ensuring an uninterrupted supply of electrical power—and associated control gear are being supplied to the New Zealand Government for installation at airports throughout New Zealand. The London sales office of Pelapone Engines Ltd. is at 38/40 Bruton Street, W.1 (Tel. Mayfair 2034).

* * *

Mr. A. E. Underwood, the Plessey Company's resident director at Swindon, said at a recent prize-giving ceremony there that three- to six-month tours of the United States were envisaged as awards for outstanding apprentices. The company was also considering a commercial apprenticeship scheme which might include girls as well as boys.

* * *

A production order has been placed with the Aircraft Equipment Department of Ferranti Ltd. for twenty of the company's 3½in stand-by artificial horizons for use in the Vickers Vanguard. Already widely employed in military and—including the Argosy, Boeing 707-436 and Comet 4—civil aircraft, it is claimed to be the most accurate 3½in artificial horizon yet produced.

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

"Weapon System"

CAN somebody explain to me the significance of the term "weapon system" which is now creeping into our vocabulary? Was not the Fokker monoplane of 1914, with its synchronized machine gun, a weapon system? And surely the B.E.2C, with its observer carrying a rifle, was also a weapon system, even if rather a bad one. And what about the eight-gun fighters of 1940?

Do we have to face the prospect of airliners becoming known as "passenger systems"?

London, N.21. PUZZLED.

[In brief, "weapon system" officially denotes an integrated concept in which nothing is an afterthought. An example is provided by the fact that in Weapon System 315A, the vehicle portion of which is the Thor missile, the specification even laid down the design of the sheet-metal stencil used to mark the packing cover which protects the hydro-pneumatic supply cart—Ed.]

Early Oddities

THERE is one point in Mr. Maurice Austin's interesting letter (January 16) that can be answered with confidence. The first elevons were used by Robert Esnault-Pelterie on his 1904 glider (see *L'Aérophile* for June 1905, and elsewhere): this was the first *use* in history of either elevons or ailerons, although Boulton had accurately described ailerons in his patent of 1868. Cody then used elevons on his ingenious and little-known glider of 1905. Santos-Dumont added ailerons, but not elevons, to his famous "14-*bis*" in November of 1906, before Blériot took up the idea of elevons in 1907, and fitted them—pivoting on the wing-tips—to his tandem-wing N. VI (*Libellule*); which therefore ranks as the first powered aeroplane to have them, although it only succeeded in making flying hops. Also in 1907, he fitted elevons to the tail of his prophetic No. VII enclosed monoplane, which in later machines were to become "crystallised" as elevators only, with flap-type ailerons appearing on the wings (as in the No. VIII of 1908) or warping, as in the No. XI of 1909.

Many of us would like to know the answers to Mr. Austin's other points. The Howard-Wright with contra-rotating airscrews did not, I believe, ever leave the ground. Contra-rotating helicopter rotors have been in use ever since Launoy and Bienvenu flew their model helicopter in 1784, which was copied later by Cayley.

London, W.1. CHARLES H. GIBBS-SMITH.

Down-grading of Documents

ROGER BACON'S remarks about the security gradings of documents (*Flight*, January 9, p. 83) contain food for thought. History can be written too soon, but it is always better for being based on as many viewpoints and sources as possible. I believe that the Americans have had a down-grading system for many years, but perhaps the new regulations will ensure wider dissemination of the newly-released material.

Aviation historians or students would welcome a similar system in this country, though public relations and library facilities are scantier. Much material of technical interest, relating to World War II, could perhaps be made available to a centre such as the library of the Imperial War Museum. Post-1945 items really come into a different category because of the sensitiveness of politicians. It would probably be difficult today to assemble runs of many of the war-time publications which could be spared for public use, but certain intelligence summaries regularly prepared by the Air Ministry in 1939-45 would provide a mine of information on ex-enemy aircraft and units. They would answer a very large proportion of queries about the Luftwaffe and possibly Nipponese aviation units, data on which are very difficult to obtain.

For those interested in the Royal Air Force there were also regular intelligence reviews published by Bomber and Coastal Commands and there seems little reason why war-time runs might not now be made available. No doubt scores of other such periodicals were produced.

One point of interest that arises from war-time intelligence reports is the vast amount of detail on enemy equipment and activities in some of them. Some at least of the data would seem to have come from P/W. interrogations, and one wonders why so much more than just "Name, rank and number" seems to have been made available to an enemy, and what pressures or inducements were used to elicit such information.

Naturally, many primary sources of real historical material will exist in single copies only, but if more data were made available in the American manner, those who wanted to get behind the officially published undocumented "histories" would get at least partial satisfaction.

Okehampton, Devon. (DR.) DENYS J. VOADEN.

The photograph forwarded by Mr. F. A. Hislop (letter in Col. 2) showing a German "pick-a-back" combination comprising a Ju88G (lower component) and an Fw190

German Composite Aircraft

YOUR correspondent Richard Bateson [November 28] made mention of the German "pick-a-back" aircraft used in connection with the bombing of the bridge at Nijmegen.

As I do not ever recall a photograph of this unusual aircraft combination being published, I send you a print of the "pick-a-back" aircraft with which I was associated in Germany at the end of the war, when attached to the Farnborough enemy-aircraft flight at Schleswig-Holstein.

You will note that a Fw190 is used as the upper portion instead of the Me109 as mentioned by Mr. Bateson.

Toronto, Ont. F. A. HISLOP.

Protesting Voice

THE recent letters on "victory scores" by enemy pilots—including some from correspondents whose names I recognize with some surprise in such a connection—seem to me to verge on the morbid. Just where does this sort of discussion get anybody? To my mind, collecting lists of this kind is even more pointless than recording serial numbers.

London, W.1. C. C. R.

"Unidentified Objects"

AFTER reading Mr. Simpson's letter in *Flight* for January 9, I would like to say that I have seen four B-52 bombers (two of them on January 2) flying due north at about 30,000ft both with contrails—one following in the wake of the other. The other two I saw today, January 23, at 2.25 p.m., again travelling due north; they, too, were contrailing at 30,000ft. All four carried *one* red object, each under the *port* wing. The aircraft were definitely B-52s, and not B-47s; with a cloudless blue sky, a pair of binoculars, and the aircraft flying overhead, I could not mistake them.

Shrewsbury, Salop. JENNIFER M. H. TUCKER.

[The letters we have published, and others received, seem to establish pretty definitely that the objects are drop-tanks and *are* carried by B-52s—Ed.]

FORTHCOMING EVENTS

Feb. 6. Helicopter Association: "Some Engineering Aspects of Helicopter Assessment Trials," by H. J. Webb.
Feb. 7. British Interplanetary Society: "High-energy Fuels and Rocket Propulsion," by Dr. F. Fitzgerald.
Feb. 11. Kronfeld Club: "The Tipsy," by C. Riddell.
Feb. 11. Society of Instrument Technology: "A Digital Instrumentation System for Use in the Testing of Jet Engines," by L. Airey.
Feb. 12. R.Ae.S. Guided Flight Section: "Earth Satellites," by W. H. Stephens.
Feb. 13. R.Ae.S.: Presidential Reception.
Feb. 13. Plymouth Aero Club: Annual Dinner Dance.
Feb. 17. R.Ae.S.: "Engine Starting Systems," by R. H. Woodall.
Feb. 18. Aircraft Recognition Society: Talk by Peter Masefield (at Royal Aeronautical Society).
Feb. 19. R.Ae.S. Guided Flight Section: "Theoretical Studies of Guided Missile Systems," by E. G. C. Burt.
Feb. 20. Avro 504 Club: Annual Reunion, Londonderry House.
Feb. 23-24. Canadian Aeronautical Institute: Special Anniversary Meeting, Queen Elizabeth, Montreal.
Feb. 24. R.Ae.S.: "Flight Development of Aircraft before and during Operation," by Dr. A. E. Russell, C. Abell and Dr. E. Warlow-Davies.
Feb. 25. Aerodrome Owners Association: a.g.m. and Annual Dinner, London.
Feb. 25. Kronfeld Club: "Some Medical Aspects of High-speed and High-altitude Flight," by Dr. R. Wombeek.

R.Ae.S. Branch Fixtures (to Feb. 13): Feb. 9, *Cambridge*, film show; *Glasgow*, Pilcher Memorial Lecture, "History of Stability and Control," by Dr. A. W. Babister; *Halton*, "Flying the F.D.2," by L. P. Twiss. Feb. 11, *Chester*, "History and Development of Manchester's Airports," by G. A. Harvey; *Manchester*, "Flight Corridor Research," by J. E. Allen; *Reading*, "Noise," by Prof. E. J. Richards.

The C.A.S., Marshal of the R.A.F. Sir Dermot Boyle, at Karachi Airport during the 20,000-mile overseas tour from which he returned home last Sunday. With him is Mr. J. R. Allison, local manager for B.O.A.C., who were hosts to Sir Dermot at Karachi

"Flight" photograph

SERVICE AVIATION

Royal Air Forces and Naval Flying News

Royal A.D.C.

RECENTLY named as the new Director of Ground Defence at Air Ministry, with effect from March 1 and with the acting rank of air commodore, G/C. K. W. Godfrey has been appointed an Aide-de-Camp to the Queen. This takes effect from November 29 last year and he succeeds A. Cdre. F. J. A. Tanner.

Far East Tour

MAKING a visit to W.R.A.F. officers and airwomen in the Far East the Director of the Women's Royal Air Force, Air Commandant Dame Henrietta Barnett, left London Airport last Monday and is due to return to this country on February 18. Her tour includes the R.A.F. stations on Singapore Island—Changi, Seletar and Fraser Hill—and also the R.A.A.F. station at Butterworth, Malaya.

M.E.A.F. Appointment

HAVING been Senior Training Officer at No. 4 School of Technical Training at R.A.F. St. Athan, Glamorgan, G/C. A. A. F. Hickman has recently become Senior Technical Staff Officer in the Middle East Air Force with the acting rank of air commodore.

He joined the R.A.F. as an aircraft apprentice then subsequently became a pilot and flying instructor but in 1940 transferred to the Engineering Branch. Before going to St. Athan he was Chief Aircraft Supply Liaison Officer to the Ministry of Supply. He is an O.B.E.

G/C. Finlay Retires

TO mark his retirement after a very distinguished Service career, G/C. D. O. Finlay was dined-out at the R.A.F. Club on January 28 by fellow-officers in the department of the Deputy Director of Intelligence (Tech.).

His distinctions have been gained both operationally and on the athletics field, the former as a Spitfire pilot and squadron commander (he won the D.F.C. in 1942) and the latter as a hurdler. In 1928, when he was 19, he became R.A.F. hurdles champion and held that title continuously (with the exception of the war years) until he retired from athletics in 1951. He was also the first holder of the Thornton Trophy (awarded to the best hurdler in the U.K.); and in 1938 he equalled the world record (14.1 sec) for the 120 yd hurdles. From 1932 to 1939 he won the A.A.A. hurdles title seven times in succession, and at the Olympic Games of 1948 he took the oath on behalf of competitors of all nations. He joined the R.A.F. in 1925 as a Halton apprentice and was commissioned in 1935. Besides the D.F.C. he holds the A.F.C. and is also an A.F.R.Ae.S. His brother, A. Cdre. Denis Finlay, is still serving in the R.A.F.

A.M.W.D. Post

SUCCEEDING Sir George H. Fretwell, who is retiring from the public service at his own request, Mr. W. G. M. Anderson has been appointed Director-General of Works. He entered the Air Ministry service in 1934 and has been one of the Directors of Works since 1952. He is a C.B.E.

Guy Gibson Scholarship

NEXT September the second Guy Gibson Scholarship will become available at St. Edward's School, Oxford. This scholarship, endowed by the Air Council and worth £40 a year, was founded in recognition of the close ties between the school and the R.A.F. Named after W/C. Guy Gibson, V.C., an old boy of St. Edward's (whose former pupils won one V.C., ten D.S.O.s and twenty-eight D.F.C.s during the war), it goes to the son of a serving R.A.F. officer for the duration of his time at the school. Applications for the scholarship should be submitted before March 1 to the Secretary, R.A.F. Benevolent Fund, 67 Portland Place, London, W.1.

No. 84 Sqn. Reunion

THIS year's reunion of No. 84 Sqn. will take place on Saturday, March 14 (7 to 11 p.m.), at the Artillery Arms, Rochester Row, Victoria, London, S.W.1. Tickets (7s 6d each) from Owen Greenwood, Flat 11, 62 Belgrave Road, London, S.W.1.

R.A.F. Postings

AMONG recent Royal Air Force appointments announced by Air Ministry are the following:

Air Ministry Wing Commanders J. R. Pullan to the Department of the Air Member for Personnel, February 2; A. B. Thomas to the Department of the Air Member for Supply and Organization, February 2; Squadron Leaders C. L. Brooks and P. Cadman to the Department of the Air Member for Supply and Organization, with acting rank of wing commander, February 2.

Bomber Command Squadron Leader J. S. Hart to No. 232 Operational Conversion Unit, R.A.F. Gaydon, as C.G.I., with acting rank of wing commander, January 28.

Fighter Command Wing Commander H. E. Beardshaw to H.Q., as Command Education Officer, February 2.

Coastal Command Wing Commander T. M. G. Bury to R.A.F. North Front, Gibraltar, for technical duties, January 28.

Maintenance Command Group Captain E. A. Harrop to H.Q., as Command Engineering Officer, February 2; Wing Commander N. W. Kearon to No. 14 M.U., Carlisle, to command, with acting rank of group captain, February 2.

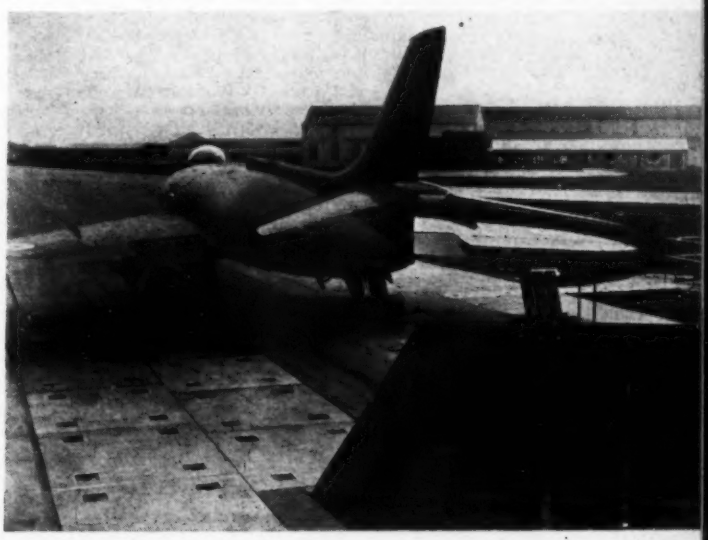
Miscellaneous Wing Commanders H. R. Hall to the Military Agency for Standardization, January 28; and K. Smith to the Armed Forces Staff College, Norfolk, U.S.A., for studies, prior to joining the British Joint Services Mission, Washington, February 2.

IN BRIEF

F/L. C. N. C. Mitchell, who is A.D.C. to Air Chief Marshal Sir George H. Mills, Commander of AAFCE, won the Curzon Cup —the most coveted international Cresta Run trophy—at St. Moritz on February 1.

* * * * *

A museum commemorating the history of British aviation is being started at the R.A.F. College, Cranwell, Lincs, and the Commandant (A. Cdre. D. F. Spotswood) has appealed for souvenirs—which will "receive an honoured and safe resting-place"—of the college and the R.A.F. station.



A Scimitar ready for take-off, with the blast deflector raised, on the steam catapult used by the Naval Air Department at the R.A.E., Bedford. R.N. pilots attached there are seen in the Flying Wing group picture *on p. 178*

Air racing pilots at the Royal Aero Club: (from the left) Cyril Gregory, 1958 King's Cup winner James Denyer, Percy Blamire, Beverley Snook, 1958 air-racing champion H. A. G. Smith, Keith Paine, Ron Paine, Walter Bowles, Geoffrey Marler, Buster Paine and Peter Clifford. The occasion was the club dinner, held in honour of Smith and Denyer, reported on this page

Sport and Business

THE NEW HEADING to this page, Sport and Business, reflects a widening of the scope of our regular Club and Gliding News feature to include the full range of club, group and private sporting aviation (including powered flying, gliding and parachuting) and—the main addition—the increasingly active world of executive aircraft and business flying. Aircraft types whose operations will be covered vary from the ultra-lightest ultra-light to the most complex of the efficient U.S. executive twins and fours.

THE NEWS that the Goodyear Trophy was to be withdrawn this year from the National Air Races prizes was announced by Col. R. L. Preston at the air racing dinner at the Royal Aero Club on Tuesday, January 27. It was hoped, however, that another race sponsor would be found. The guests of honour at the dinner were H. A. G. Smith, the Canadian proprietor of the Flaxdressers Inn, Ashby-de-la-Zouch, who became 1958 British Air Racing Champion; and Jim Denyer, winner of last season's King's Cup race.

A replica of the championship trophy was presented to Mr. Smith by Mr. Stuart Scott-Hall, chairman of the R.Ae.C. racing committee. In a brief speech in reply, Mr. Smith disclosed that his first racing season, 1958, was also to be his last, for medical reasons. But he hoped to follow the jockey's practice of becoming a trainer after retiring from active racing: he had an aircraft and a protegé pilot; they would race this season; and they would win the 1959 King's Cup. Opinion on this last point was far from unanimous when it was discussed by a representative bunch of race pilots at another West End establishment later that night.

AT A MEETING in Grimsby on January 22 it was decided to form a Grimsby Flying Club. A working committee had already begun preliminary negotiations, and the club presidency has now been accepted by Air Cdre. J. L. Kirby. The club aims to have an aircraft operating at its base at Waltham, near Grimsby, by Easter, and hopes to have fuelling and other facilities available for visiting aircraft. The old control tower at Waltham is being converted for use as a club-house.

NATIONAL RALLY of the Popular Flying Association for 1959 will be held during the weekend of September 5-6. The location has not yet been chosen. The Association recently affiliated its 155th Group, and the January issue of the P.F.A. journal *Popular Flying* contains a reprint of the Association's outline giving details of the formation and operation of co-ownership groups in general. Also included in the issue, under a black-edged heading "Croydon Airport," is a criticism of Mr. Harold Watkinson, Minister of Transport and Civil Aviation, which ends with the statement: "This Association deplores and condemns the action of the Minister in closing Croydon to sporting aviation and suggests that in view of the serious harm done to civil aviation he should resign from his aviation activities forthwith."

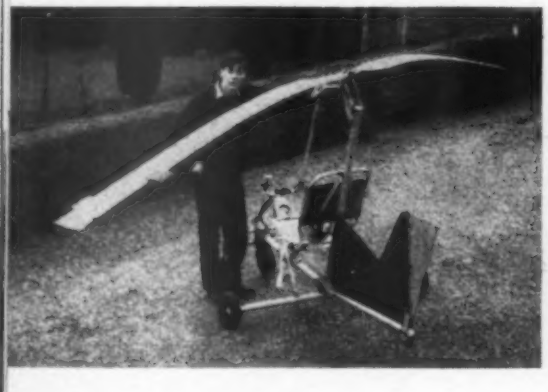
MANUFACTURERS of the Jodel D.140 Mousquetaire, Société Aéronautique Normande have announced that the type has passed its French C. of A. tests at the full gross weight of 1,200 kg, with a useful load of 600 kg, without any restriction or modification. The fourteenth Mousquetaire has now been delivered and numbers 8 and 9 have been successfully ferried to Madagascar.

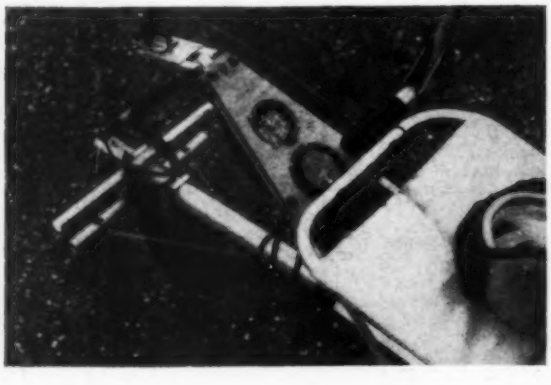
AIRCRAFT equipped for glider-towing are being sought by the organizers of this year's National Gliding Championships, to be held from Sunday, May 10 to Monday, May 18 at Lasham. Information concerning tugs available for this period would be welcomed by tugmaster David Darbishire at Lasham Gliding Centre.

ANNUAL GLIDING BALL organized by the British Gliding Association will be held this year on Friday, March 13, from 8.30 p.m. to 2 a.m. at Londonderry House. Tickets cost £1 including buffet supper and are obtainable from gliding clubs or the Association. Annual general meeting of the B.G.A. will be held at 2.30 p.m. on March 14, also at Londonderry House.

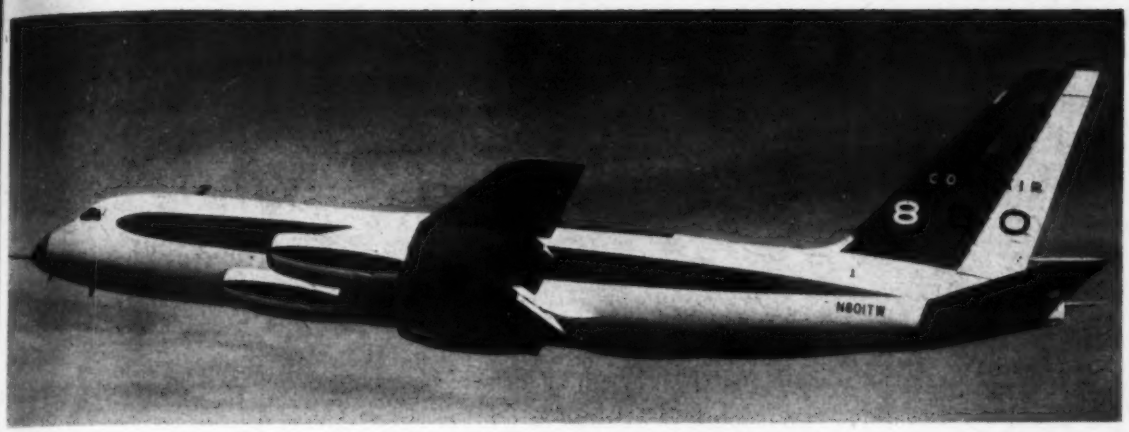
A PARACHUTING GROUP is being formed at Stapleford Aerodrome by Miss Sue Burges and Mike Reilly, with the object of specializing in formation delayed drops for air displays. Tiger Club aircraft will be used in addition to local club aircraft from Stapleford.

APPROXIMATELY SIX MONTHS' spare-time work was needed by J. M. E. Smith of Solihull, Birmingham, to build the Bensen B-7 Gyro-glider shown in the photographs below. All components are built of aircraft-quality material, the fuselage of bolted aluminium-alloy tube and angle-plate, the rotor-head of high-strength aluminium alloy, and the blades of fabric covered plywood with a reinforcing steel spar. The machine was built from Bensen drawings and, Mr. Smith reports, "all that is required is a lathe and drill press, although access to a milling machine is a help." For its first flights the machine is to be towed behind a car; take-off speed is quoted as about 18 m.p.h. and landing speed about 7 m.p.h. for an all-up weight of 250 lb.





Home-built Gyro-Glider: this Bensen B-7 was constructed by J. M. E. Smith of Solihull in six months (see news item above). Altimeter and A.S.I. are the only two instruments carried



The first Convair 880 (four G.E. CJ-805) on its successful maiden flight from San Diego on January 27 (see first news-item below)

AIR COMMERCE

CONVAIR DOES THE IMPOSSIBLE

ON January 27 the Convair 880 took off from Lindbergh Field, San Diego, on its maiden flight. After an hour and 14 minutes in the air the new airliner landed at the U.S. Naval air station at North Island, where it is now completing the first ten hours of test flying.

As far back as June 1956 the date for the 880's first flight was set at January 30, 1959—a target that was widely considered to be near impossible. The project, at first known as the Skylark 600, had been originally announced in April 1956. The following June saw orders placed for 40 Convair 880s (Golden Arrows)—30 for T.W.A. and 10 for Delta—and the following time-table was revealed: fabrication to commence, September 1957; mating of fuselage and wing structures, September 1958; first flight, January 30, 1959; first delivery, November 1959; and final certification, May 1960.

Subsequent orders for 880s were placed by Transcontinental (four), Real (four), and Swissair/S.A.S. (five). Including a probable order for nine aircraft from Captital, the 880 order book now stands at 62. In addition, an order for 25 Convair 600s has been placed by American Airlines. Delivery of current 880 orders should be completed within 1960, construction being closely dovetailed into the 600 programme. First flight of this latter type is scheduled for August next year, and delivery should start from June 1961. The 600 is slightly larger, and has CJ-805-21 turbofans.

ARGENTINA'S FRIENDSHIPS

MORE details are now available on Aerolineas Argentinas' order for Fairchild Friendships. Ten will probably be needed for the internal and regional services, and an option will be placed on a further ten. The aircraft will be fitted as standard 40-seaters, and this should ensure that delivery will not be delayed; the whole fleet should be in operation before the end of this year.

The choice was founded on the early availability offered by Fairchild and on the F27s take-off and landing performance under local conditions. The airline has specified Dart 511s, it apparently being felt that these engines meet the operator's needs rather more closely than the more powerful 528s.

WORLD'S LARGEST AIRLINE

DESPITE the claims of Air France, the honour of being the world's largest airline belongs comfortably either to American Airlines or to United Air Lines. In the past few years United have been gradually catching up with their rival and over the first half of last year the two were level-pegging (see *Flight*, October 3). Subsequent monthly figures did not suggest that United were drawing ahead, but if American have in fact moved down into the unaccustomed No. 2 position one reason may have been the three-week strike that grounded them at the year's end.

It is perhaps significant that no statement has yet come from American showing their preliminary annual financial and traffic statistics. This statement is normally issued in mid-January. Even when allowance is made for the commotions caused by the strike and by inaugurating 707 and Electra services, the continued silence is a curious sign.

United, on the other hand, have wasted no time in publishing data for 1958. Operating revenues rose to a record $317m, operating expenses reached $286m, leaving a net profit after tax of $14m. The airline's president, Mr. W. A. Patterson, admits that "strikes against major competitors diverted additional traffic to us." Last year saw his airline's traffic reach record levels: 7.3 million passengers, 5,213 million passenger-miles and 112 million cargo ton-miles (increases of 9, 7 and 17 per cent respectively).

United are unlikely to base a public-relations campaign on this development: firstly, if indeed they have a traffic lead over American then the lead is marginal; secondly, United are likely to trail well behind American in the immediate future as Mr. C. R. Smith's jet programme is put into effect.

GUNNING FOR COMMANDOS

A BITTER Press campaign has developed in Argentina over the use of Curtiss Commandos by two of the country's airlines. This follows the recent tragic crash of one of these aircraft in the sea off Mar del Plata, causing the loss of 51 lives.

Upon approaching to land at Mar del Plata an Austral C-46 was diverted by Traffic Control, the pilot being instructed to make a fresh approach. At that moment a severe squall hit the area, after which the aircraft appeared to struggle unsuccessfully to maintain altitude; it then plunged into the sea.

About three months ago a Transcontinental C-46 effected an emergency landing on a small private airfield and although there were no fatalities, the aircraft was completely destroyed. Shortly after this incident another C-46 made a successful belly landing on a grass strip parallel to one of the main concrete runways at Ezeiza. These three accidents have led to suggestions that the National Civil Aviation Bureau should consider grounding all C-46s.

American Airlines' jet age dawned in the last week of January. Lockheed Electras (right, below) and Boeing 707-123s began operating scheduled services from New York to Chicago and to Los Angeles respectively

AIR COMMERCE . . .

MORE ACCIDENT STATISTICS

THE tabulated list of 1958 airline accidents published in the January 16 issue of *Flight* has brought a number of requests from operators, authorities and others for a comparable list of fatal accidents which occurred in 1957, and we have accordingly compiled the table below. Relating to the world's scheduled and non-scheduled airlines, it is based on all the information available to us but does not, of course, claim to be in any way official. The I.C.A.O. digest of accidents for 1957 is yet to be published.

Month	Date	Airline	Nationality	Aircraft	Fatalities		Location	Circumstances
					Pass.	Crew		
January	7	American	U.S.	CV.240	1	–	Tulsa, Oklahoma	Approach in low cloud
	11	LADE	Argentina	Viking	6	5	Buenos Aires	Take-off
	19	PanAm	U.S.	DC-3	—	1	Idlewild	Test flight
	23	LANICA	Nicaragua	DC-3	13	3	Nicaragua	In mountains
	23	Vestlandske	Norway	Seabee	2	–	Baroen	Ambulance flight
	29	SAGETA	France	Armagnac	1	–	Orly	Instrument landing
February	1	Northeast	U.S.	DC-6A	20	1	La Guardia	Take-off in storm
March	2	Alaska	U.S.	DC-4	2	3	Washington	
	9	Aviance	Colombia	DC-3	12	3	Cali	In mountains
	13	I.A.C.	India	DC-3	—	2	New Delhi	Training flight
	14	B.E.A.	U.K.	Viscount	15	5	Manchester	Flap failed on approach
	19	L.A.B.	Bolivia	DC-3	16	3	Bolivia	In mountains
April	7	Varig	Brazil	C-46	35	5	Rio Grande do Sul	Engine fire
	8	Air France	France	DC-3	27	5	Biskra, Algeria	Take-off engine failure
	10	REAL	Brazil	DC-3	22	4	Rio de Janeiro	Engine unserviceable
	15	TAMSA	Mexico	Liberator	—	3	Merida	Obstruction on take-off
	20	Air France	France	L.1049	1	–	Iran Turkish border	Pass. sucked through burst window
May	1	Eagle	U.K.	Viking	28	5	Blackbushe	Take-off engine failure
	2	Wideroes	Norway	Cessna 170	2	1	Norway	
	5	I.A.C.	India	DC-3	—	1	Assam	Freight service
	9	Aviaco	Spain	BR-170	32	5	Madrid	Approach stall
	13	U.S. Overseas	U.S.	DC-4	—	2	Narsarssuak	Freight service
	13	LADE	Argentina	Viking	11	5	Buenos Aires	In mountains during storm
June	14	L.O.T.	Poland	Il-14	9 (incl. crew)		Moscow	In violent storm
	18	Swissair	Switzerland	DC-3	—	9	Lake Constance	Training flight
	22	Capital	U.S.	DC-3	—	3	Maryland	Training flight
	23	Pac. West	Canada	DC-3	12	2	Port Hardy, B.C.	Take-off
	25	SAMSA	Colombia	C-46	—	2	Medellin	
	27	Wien Alaska	U.S.	Norseman	1	–	Alaska	In mountains
July	1	P.I.A.	Pakistan	DC-3	20	4	Bay of Bengal	In storm
	16	K.L.M.	Netherlands	L.1049	47	8	Biak	Take-off engine fire
	25	Western	U.S.	CV.240	1	1	Mojave Desert	Explosion, victim blown out
August	11	Maritime Can.	Canada	DC-4	73	5	Quebec	In storm
	15	Aeroflot	U.S.S.R.	Il-14	18	5	Copenhagen	Struck chimney in fog approach
	16	Varig	Brazil	L.1049	—	1	Dominica	Engine failure
	20	Indamer	India	DC-3	5	3	Assam	Freight service
	30	Kroonduif	Dutch	Twin-Pioneer	—	2	New Guinea	Instruction flight
September	1	I.A.C.	India	DC-3	—	3	Calcutta	Struck on runway by landing Hermes
	4	Avensa	Venezuela	DC-3	4	5	Trujillo	Instrument flying off course in storm
	15	Northeast	U.S.	DC-3	8	2	New Bedford	Hit trees during instrument approach
	18	REAL	Brazil	CV.240	—	1	Montevideo	In fog
	18	Ellis	U.S.	Cessna 180	2	1	Alaska	Lost control, ditched in lake
	27	B.E.A.	U.K.	Heron	1	2	Scotland	Ambulance service
October	1	Pac. West	Venezuela	Stranraer	—	4	B.C.	On take-off
	3	L.I.A.	Lebanon	C-46	23	4	Beirut	Take-off engine failure
	23	B.E.A.	U.K.	Viscount	2	5	Belfast	On approach
	28	Iberia	Spain	DC-3	17	4	Madrid	Hit mountain
	29	TAMSA	Mexico	Fairchild Pkt.	—	3	Campeche	Freight service
November	4	TAROM	Rumania		1	3	Moscow	On landing
	9	PanAm	U.S.	Stratocruiser	36	8	In Pacific	Fire
	15	Aquila	U.K.	Solent	36	8	I.o.W.	Engine fire, struck cliff
	15	Aviaco	Spain	Heron	2	2	Palma	Hit mountain at night
	16	Kroonduif	Netherlands	Beaver	1	2	New Guinea	Struck tree on approach
	21	SAFE	New Zealand	BR-170	2	2	Christchurch	Wing broke in flight
December	8	A-Argentinas	Argentina	DC-4	55	6	Bolivar	In severe storm
	23	Scottish	U.K.	York	—	4	Essex	On instrument approach

PHEASANTS AIRBORNE

A FREIGHT charter of an unusual nature was recently undertaken by Derby Airways. A specially modified DC-3, G-ANTD, left Elmdon Airport for Copenhagen to bring back 2,100 live pheasants for the charterer—Warwickshire Pheasantries, of Pailton, near Rugby.

Travelling on the flight was Mr. E. F. Castle, head gamekeeper at the pheasantries. At Copenhagen he supervised the transfer of the birds into hampers which were stowed and secured aboard the aircraft. Only a few hours before, the birds had been flying wild in the Danish woods. Mr. Castle explained, "We are buying Danish pheasants because of heavy losses over the past two hatching seasons and also because the Danish ringneck hen pheasant is particularly suitable for mating with the blackleg, the Chinese and the Manchurian strains for which we are internationally known."

The advantage of air charter for this valuable cargo (it was worth about £4,000) reduced to about 12 hours the time during which the birds were confined to hampers. Special arrangements by the Ministry of Agriculture and Fisheries and by H.M. Customs resulted in the immediate unloading of the pheasants on arrival

Mr. E. F. Castle—see news-story above—examines one of his 2,100 pheasants in transit. (Right) The birds leave Elmdon by truck

In the control tower at Nairobi Airport, students from Uganda watch a B.O.A.C. Britannia being cleared for take-off

at Elmdon and their transfer by road to Pailton, where the necessary quarantine period is being passed in pens specially approved for the purpose in the grounds of the pheasantry itself.

Warwickshire Pheasantries have imported Danish birds before. On one occasion a consignment came by sea and over 500 birds were found to be dead on arrival. This time, a spokesman of the pheasantries said, "Casualties are negligible. We are delighted at the arrangements made by Derby Airways and will certainly fly all our birds over in future."

THE CANADAIRLINER

AS briefly reported in these pages last week, Canadair rolled out the first 540 in mid-January. The second is expected to follow within the next few weeks.

These first two aircraft, bearing the colours of Air Transport Command, R.C.A.F., are Convair 440 airframes (sent up from San Diego to Montreal) which have been modified by Canadair to take Napier Eland 6 turboprops. The R.C.A.F. have ordered ten of these aircraft, designated CC-109, and will use them primarily in a freight-carrying rôle. Frames for the final eight of this order will be entirely constructed at Montreal.

Exterior dimensions of the 540 are similar to those of the 440. The cabin length has, however, been extended to 39ft 9in, and this will permit the airline version to carry 48 passengers (or 58 in high-density configuration) as against 44 in the standard 440. Maximum take-off weight of the new turboprop is 53,200 lb.

LONDON AIRPORT HOTEL

WORK is likely to start on a new 264-bedroom hotel near London Airport as soon as planning approval is granted. Financed by a Canadian group headed by Mr. Louis Epstein, chairman of Seaway Hotels in Toronto, it is expected to cost about £1 million.

The chosen site is on the north side of the Bath Road opposite the existing international arrival buildings at London Airport North. The sponsors hope that the building—to be known as the Skyway Hotel—will be completed by the end of the year.

BLEAK NOVEMBER

LAST week's fogs were reported to have been the worst experienced in London since 1952. B.E.A. have blamed their disappointing December traffic on the Christmas fogs. And now the M.T.C.A. attributes November's poor showing—aircraft movements fell by 6 per cent and passenger traffic by 1 per cent—to that month's fog.

November is always one of the worst months of the year, both for weather and for traffic generally. In this month last year no fewer than 163 diversions took place, and total passenger traffic fell to a seasonal trough of ¼ million (peak monthly traffic in August reached well over 1m passengers).

The general pattern over the country was that passenger traffic rose in the London area by 4 per cent but fell at airports elsewhere by 10 per cent. One notable exception was Edinburgh, where traffic—presumably under the influence of B.E.A.'s new cheap weekend return fares—rose by 17 per cent. Blackbushe, Newcastle, Bournemouth and Stansted also showed increases. Airports at which traffic fell sharply were Bristol, Southampton, Birmingham and Cardiff.

VOICE OF THE COMMON MAN

OF the many factors that have to be borne in mind by licensing authorities, that of conforming to the public need is—or should be—uppermost. But when an authority has to adjudicate between established higher-fare operators and energetic low-fare newcomers it is not always easy for the regulating agency to establish the best course.

The application of Eagle Airways to operate services to many cabotage points within the Commonwealth at fares very much below the present level has presented a particularly thorny problem to licensing authorities, for the general public in various parts of the Commonwealth have apparently taken sides very strongly with Eagle. In recent weeks the public at home seems to have been obsessed with the subject of air hostesses' hemlines, and surprisingly little interest has been expressed in the subject of cheaper travel. But in the overseas territories the number of letters appearing in correspondence columns bears witness to a widespread and sincere desire to see a drastic cut in air fares.

The East African papers, in particular, have been inundated with a stream of such letters, and representatives of Kenya's Legislative Council are being urged to support the low-fare application. The suggestion has even been put forward that the Government be presented with a petition.

TUGS FOR BIG JETS

AT London Airport last week representatives of a number of major airlines watched demonstrations of the Douglas Tugmaster tractor's capabilities in handling civil aircraft of the largest size, Pan American having placed a Boeing 707 at the disposal of the manufacturers, Douglas Equipment Ltd., of Cheltenham, Glos. The tractor demonstrated was the first of six recently ordered by Qantas in readiness for that operator's 707s.

Flight was able to watch a test being made on the apron in front of the PanAm hangar, and it was certainly a convincing one. The 707-121 *Clipper Mayflower* was brought out of the hangar for two Esso refuellers to top up its main tanks to a fuel weight of 60,440 lb, giving an aircraft weight of 180,000 lb. The Tugmaster then took charge and virtually played with the big airliner, towing it at various speeds and turning it in circles of surprisingly small radius. In spite of the fact that early morning frost and ice-patches covered the apron there was no sign of wheelspin; and there was certainly no reason to question the statement that the Tugmaster would have been equally at ease had the 707 had its full fuel load on board, implying a total weight of some 233,500 lb.

The Tugmaster is in fact designed to handle aircraft of up to 300,000 lb on the 230 b.h.p. of its Leyland six-cylinder diesel. The following performance figures are quoted:—

First Gear: Maximum tractive effort, assuming 90 per cent overall mechanical efficiency, 31,800 lb at 1.4 m.p.h. Maximum speed, 7.5 m.p.h. (tractive effort, 9,000 lb).

Second Gear (normal towing gear): Maximum towing speed with aircraft at 300,000 lb and tractor at 13 tons (assuming 90 per cent efficiency and 50 lb/ton tractive resistance), 11 m.p.h. Minimum speed 2.3 m.p.h. at tractive effort of 30,000 lb.

Third Gear: Maximum towing speed assuming 30 lb/ton tractive resistance (all other assumptions as above), 16 m.p.h. Minimum speed 3.1 m.p.h. at tractive effort of 14,000 lb.

Top Gear: Speed running light, 20-24 m.p.h.

Wheelbase is 8ft and overall dimensions are 16ft long×7ft 10in wide by approximately 5ft high. Equipment includes hydraulic transmission and self-changing gearbox; 9.00×20 twin rear and 7.50×20 single front tyres; power-assisted steering (optional extra); pneumatic front and air/hydraulic rear brakes; 25-gal fuel tank; 24 V batteries for lighting (which includes two swivelling flood-lamps to illuminate the tow); and crew-seats for four in addition to the driver.

First-class seats fitted to Aerolineas Argentinas' Comet 4s were designed by de Havilland and built by Lancefield Aircraft Components, Ltd. The double seat shown weighs only 60 lb (62¼ lb with foot-rest)

Construction of Westland's heliport at Battersea—on the River Thames near central London—is now nearing completion

AIR COMMERCE . . .

SOUTHALL ACCIDENT INQUEST

AT the resumed inquest, at Ealing last week, on the seven people (including three aircrew) killed when Viking G-AIJE crashed on houses at Southall on September 2, the jury returned an open verdict after deliberating for an hour.

As soon as the verdict was announced there was a clash between Dr. J. A. Gorsky, the Deputy Coroner for West Middlesex, and Mr. Ronald Hopkins, counsel for Independent Air Travel Ltd., the owners of the aircraft. Addressing the Deputy Coroner, Mr. Hopkins said:—

"This inquiry being now completed, would you please allow me to say two things? The first is that my clients desire to offer sympathy to the relatives of all those persons who died and to those who suffered in this crash. The second is that in the course of the hearing and during your summing up to the jury you made a number of assumptions and accusations against Independent Air Travel Ltd. and their employees which were not supported by a shred of evidence.

"Unfortunately these observations may again find their way into the Press, as has happened throughout the inquiry, where they would be read by persons who have had no opportunity of forming their own judgment in the matter. I am, therefore, desired to state publicly that my clients strenuously dispute all the charges you have seen fit to level against them, and if the verdict of the jury had been other than in fact it was, they would on advice have applied to the High Court to set it aside. They will now look forward to the day when an impartial tribunal will investigate at a proper public inquiry the causes of this unfortunate accident."

Dr. Gorsky: "Mr. Hopkins, are your clients suggesting this has not been impartial?"

Mr. Hopkins: "I make no suggestion at all."

Dr. Gorsky: "You made a suggestion that is equal to—in fact, more serious than—the one I made."

Mr. Hopkins: "You quoted Pontius Pilate at an earlier stage in these proceedings. I will now quote him also: '*Quod scripsi scripsi.*' ("What I have written, I have written.")

Dr. Gorsky: "And we await the reply. My conscience is clear. This has been quite impartial. I could have said a lot more."

Earlier, in his summing-up, Dr. Gorsky had made a series of strong criticisms, saying that there had been "a considerable amount of laxity" in the conduct of the company, and that its pilots, including Capt. Kozubski, the managing director, "appeared to have a considerable amount of licence."

In view of the conflicts which have characterized the inquest, both at the first and at the resumed hearings, *Flight* feels disinclined to report it in any detail, preferring to await the public inquiry into the accident. In this connection it is apposite to quote a statement made by the British Airline Pilots' Association in the January issue of their journal *The Log*. This, which refers to the first hearing, says:—

"The Committee noted that the procedures which had been adopted by the Coroner and the evidence which he had called for were equivalent to those of a Public Inquiry. The Committee noted that no opportunity had been given for a detailed examination of the evidence and therefore each Counsel and his Advisers were handicapped when witnesses were being examined; a situation which would not arise at a properly conducted Court of Inquiry. Members expressed their dissatisfaction with the way the Inquest had been conducted, but had to accept that the Coroner was answerable only to the Crown and therefore had extraordinary powers."

BREVITIES

Eagle Aviation have taken delivery of a third DC-6C. The aircraft, registered G-APSA, is being converted to take 100 seats.

* * *

Mr. R. G. Grout, chairman of General Steam Navigation Co. Ltd., has been appointed to the Board of British Aviation Services Ltd.

* * *

Britannia 102s will replace Stratocruisers on B.O.A.C./Nigerian Airways/Ghana Airways services between Europe and West Africa from mid-April.

* * *

The Ceylon Government have increased their share in Air Ceylon to 74 per cent, the balance being retained by K.L.M. The local airline's manager, Mr. J. Fernando, has disclosed that Air Ceylon made a profit of Rs. 200,000 last year.

* * *

Further negotiations between the British and Indian governments on the bilateral agreement have been postponed until discussions are completed between B.O.A.C. and Air India. All-India Radio has reported that traffic data are already being exchanged and that a conference on revenue pooling will probably be held in May.

Routine inspection recently revealed an 8in hairline crack in the skin of a PanAm 707-121 near the wing-root.

* * *

Mr. Ernst van der Beugel, an expert in foreign affairs, will become a director and acting president of K.L.M. in January 1960.

* * *

The C.A.B. has denied Northwest Airlines permission to complete a management contract with Thai Airways.

* * *

A six-day suspension of all air services in Mexico as a result of a pilots' strike ended last week when the government temporarily took over the local airlines.

* * *

J.A.L.'s plans for 1959 include a Tokyo - Honolulu - Los Angeles service from May 1, a Tokyo - Seattle non-stop service from June 1, a Tokyo - Taipei - Hong Kong service from July 1.

* * *

An Air Charter Tudor freighter crashed on take-off from Brindisi on January 27. Two members of the crew of six lost their lives.

* * *

Representatives of Sabena, Air France, D.L.H., Alitalia and K.L.M. are due to meet in Paris on February 27 to consider possible forms of integration within the general framework of the Common Market.

* * *

Dismissal of Airwork senior pilots, following the reorganization involving Air Charter and Transair, is the subject of an article by the general secretary of B.A.L.P.A. in the January issue of the Association's journal *The Log*.

* * *

The M.T.C.A. have proposed to Aeroflot that the Tu-104 use London Airport on a trial basis. This would cover the employment of techniques to reduce noise level to that of the Comet 4 or Boeing 707. Aeroflot have also been asked for an assurance that international standards of airworthiness be followed.

The first Comet 4 for Aerolineas Argentinas flew on January 27

UNIVERSITY OF MICHIGAN